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AMERICAN WATER WORKS ASSOCIATION

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Chlorine-Ammonia Treatment
Committee Report

Taste and Odor Control *Hassler*

Census of Softening Plants *Olson*

Machinery Insurance *Graham*

Small Plant Billing *Ogden*

Depth Sampler

Fluoride Determination *Elvove, Goudey*

Revision of Drinking Water Standard
Wolman, Hoskins, Buswell, Hirsch, Billings, Chase, Noble

Tentative Specifications for Cold Water Meters

1941 Convention and Section Meetings

Index for 1941 Journal

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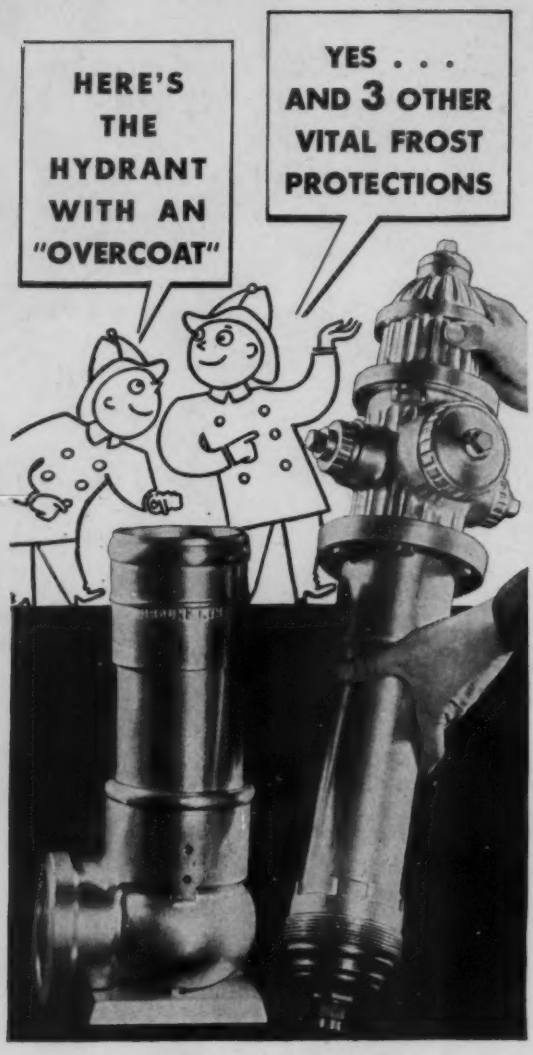

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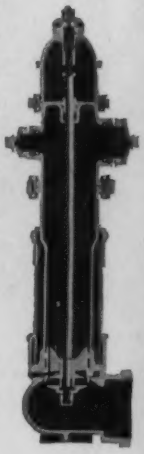

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Contents

Chlorine-Ammonia Treatment of Water. Committee Report 2079
The History of Taste and Odor Control. By William W. Hassler 2124
Census of U. S. Municipal Water Softening Plants. By H. M. Olson 2153
Machinery Breakdown Insurance. By A. F. Graham 2192
Billing Procedure for a Group of Small Plants. By William H. Ogden 2201
Depth Sampler 2207
Comments on Committee Report on Methods of Determining Fluorides. By Elias Elvove and R. F. Goudey 2210
Revising the U. S. Standards for Drinking Water Quality. Discussions by Abel Wolman, J. K. Hoskins, A. M. Buswell, A. A. Hirsch, L. C. Billings, E. Sherman Chase and Ralph E. Noble 2215
Tentative Specifications for Cold Water Meter—Displacement Type ..... *A section of this issue*
The 1941 Convention 2227
Résumé of 1941 Section Meetings 2237
Index for Volume 33, 1941 2251
A.W.W.A. Publications—A List ..... *A section of this issue*
Coming Meetings vi
Changes in Membership viii
News of the Field 1

Due to the extent of the text and the Annual Index, the Abstract Section is withheld from this issue

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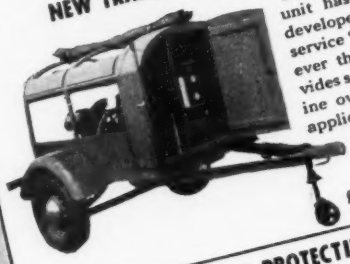

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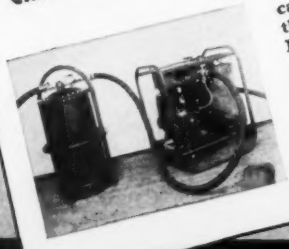

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Vol. 33 December, 1941 No. 12

Chlorine-Ammonia Treatment of Water

Committee Report

ALTHOUGH the treatment of water supplies with chlorine and ammonia was first suggested and used more than twenty years ago, it was not until about 1930 that the procedure was generally accepted in this country. Since then the successful control of taste and odor by this method has strengthened its popularity. Unfortunately many of the practices related to its use are based largely on empirical data. In September 1936, the Water Purification Division appointed a committee to study the use of chlorine and ammonia in the treatment of water supplies. As originally constituted, the Committee had the following members who were no longer serving at the time of this report: J. F. T. Berliner, Wilmington; K. W. Brown, Stockton; and Roberts Hulbert, Detroit.

The Committee planned a comprehensive study of the various factors concerned in the use of chlorine and ammonia, including a review of the literature, the preparation of an extensive bibliography, and the compilation of data based on the results of field investigations and actual treatment of supplies throughout the country.

The general acceptance of chlorine-ammonia treatment as a standard and the almost universally satisfactory results obtained have militated against investigation by operators into the fundamentals upon which the treatment is based.

A committee report presented on June 25, 1941, at the Toronto Convention by F. W. Gilcreas, *Chairman*, Associate Sanitary Chemist, Div. of Labs. & Research, State Dept. of Health, Albany, N. Y.; revised and made available for publication on October 24, 1941.

In addition to the studies concerning the conditions necessary for the formation of chloramines in water, the effect of chlorine-ammonia treatment in maintaining pipe line capacity and its functions in the control of growths of plankton when used in conjunction with copper sulfate have been investigated. The Committee also studied other phases of the problem, including the loss of ammonia in distribution systems, tests for residual chlorine as chloramines, and the efficiency of the treatment in the control of taste and odor conditions, and in the removal of bacterial contamination.

In describing the treatment of water with chlorine and ammonia the terms "chlorine-ammonia treatment" and "chloramination" have generally been used synonymously. Because of the uncertainty as to the formation of chloramines in the dilute concentrations employed in water supplies, the tendency has been to favor the more conservative description "chlorine-ammonia treatment"; this practice has been followed in general in this report. However, in view of the available evidence regarding the probable formation of chloramines under controlled conditions of hydrogen-ion concentration and in dilute solutions, the terms may be considered synonymous.

Certain sections of this report have been prepared by the members indicated and to each, rather than to the Committee as a whole, belongs credit and responsibility for the material therein recorded.

Survey of Literature—*Harry A. Faber**

Reference to the technical literature shows that much valuable information is already available concerning chlorine-ammonia treatment of water. Reference to many of these studies has been made in the "Bibliography and Abstracts on the Chloramine Treatment of Water" prepared as a project of the U. S. Works Progress Administration, sponsored by the Department of Sanitation of New York City, under the direction of the late Lewis V. Carpenter. Included in that report are 119 references without annotations and 123 abstracted references.

The Committee recognizes that this is not and does not purport to be a complete bibliography on the subject. Since it extended only to 1937 we have included further data which appeared during 1937–41. These are listed in the Appendix. References added are those readily available and do not represent a complete search of the literature.

It seems pertinent to review this background of the chlorine-ammo-

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nia method of water treatment as a basis for evaluation and further study of the method. This will indicate certain general conclusions which can be drawn, and should disclose some of the answers to problems that have not been solved.

Terminology. It is a significant comment that the term "chloramine treatment" has gradually been replaced by the term "chlorine-ammonia treatment" or "ammonia-chlorine treatment." Original studies which led to the application of chlorine and ammonia to water treatment were largely devoted to the preparation and properties of the true chloramines (mono-, di-, and tri-chloramines). Despite the fact that the first to use such treatment, Sir Alexander Houston in London and Race in Toronto, applied pre-formed chloramines to water supplies, this procedure has not been generally true of practice in the United States. Rather, chlorine and ammonia or their compounds are added to the water separately.

There are several reasons for questioning whether true chloramines are in most instances formed by this method of application. The maintained ratios of chlorine to ammonia frequently are far different from those theoretically required; the temperature, pH, and ammonia content of the water to be treated are seldom taken into consideration—yet the reaction that occurs is definitely affected by these conditions.

Nevertheless, it has been adequately demonstrated in operating experience that the addition of ammonia, either before, with, or after the addition of chlorine to water does result in the formation of some new combination of chlorine. The properties of this new combination are similar to those of true chloramines. Any differences that exist, however, may serve to explain certain peculiarities between theoretical reactions of chloramines and the observed reactions in chlorine-ammonia treatment of water supplies.

Effect on Tastes and Odors. The chlorine-ammonia method of treatment received its greatest impetus toward widespread adoption because of its property of reducing medicinal tastes produced by reaction of chlorine alone in certain waters containing phenolic compounds. The method was first used in 1926 by McAmis at Greenville, Tenn.; then by Spaulding at Springfield, Ill., and by Ruth at Lancaster, Pa., in 1928. Several investigators subsequently reported on laboratory studies of this property and, beginning about 1930, chlorine-ammonia treatment found increasing favor. Its value soon

became apparent in preventing formation of other tastes, particularly those due to algae.

Although physiologically taste and odor are identical, there are listed separately in the "Bibliography and Abstracts on the Chloramine Treatment of Water" 55 references to odor and 30 references to taste. Of the latter, 15 mention phenolic tastes and, almost without exception, that the application of ammonia prior to chlorine proved capable of eliminating or markedly reducing tastes of this nature. Algae tastes predominate among other types listed, and these too were generally found to be susceptible to improvement with chlorine-ammonia treatment. In a number of references no specific taste is named, but improved conditions are reported to result from the substitution of chlorine-ammonia treatment for chlorine alone.

When the doses of chlorine and of ammonia and the ratio of one to the other are considered in connection with a taste condition, it is impossible to find a correlation. Frequently no data as to dose and ratio are given; often the data are too meagre to be of value. In no instance is evidence reported which provides useful data to show any correlation between concentration of algae, type of algae, or concentration of phenols and the dose or ratio of chlorine and ammonia.

To prevent or reduce tastes which are produced in water by the reaction of chlorine with phenols, algae, and other types of organic substances, the addition of ammonia is almost always successful. The point of addition of ammonia must precede the point of addition of chlorine to accomplish this purpose. The dose of chlorine and of ammonia, as well as the ratio of the two, appears not to be specific. It is indicated only that a relatively narrow ratio of chlorine to ammonia, with 1:1 as the lowest and 4:1 as the highest, has been reported to be successful for this purpose. Thus the typical 3:1 ratio appears to be generally satisfactory in the use of chlorine-ammonia treatment for taste control.

In the references to odor control, about half give no designation as to the type of odor; only a third mention data on chlorine-ammonia dosage. With but two exceptions, however, those who report the effect of such treatment state it to be successful. The data given are too limited to indicate optimum conditions for obtaining the most satisfactory results.

General conclusions may be drawn with reference to use of the chlorine-ammonia method for control of those tastes and odors which are formed or increased by reaction with chlorine in the water. The

addition of ammonia prior to the addition of chlorine has been generally successful, the preferred ratio of chlorine to ammonia being reported usually as 3:1. Present methods of evaluating tastes and odors with considerable accuracy were not available, or in general use, at the time most of these studies were reported, which may account for the rather generalized statements regarding tastes and odors in these references.

Effect on Algae. When the chlorine-ammonia method was adopted as pre-treatment for control of tastes and odors, it was almost always noted that algae growths were markedly reduced. Data in the 22 references on this subject which appear in the bibliography support such observations.

Again the data reported are seriously limited with reference to correlating dosage, ratio, types of algae, and characteristics of the water. Hence, only the general conclusion may be drawn that the chlorine-ammonia method of treating water prior to filtration or to storage in reservoirs has been definitely indicated to reduce algae growths with a consequent improvement in appearance of settling basins, in length of filter operation, and in reduction of aftergrowths in reservoirs. The ratios of chlorine to ammonia ranged from a low of 1:1 up to a high of 12:1. No satisfactory correlation between ratio or dosage and result can be established from the data given.

Effect on Iron Bacteria. In the limited number of instances reported, chlorine-ammonia treatment appears to be especially effective for either inhibiting or destroying iron bacteria. No definite dosage or ratio appears to be indicated for this purpose, and the effect seems to be due to long persistence of residual chlorine rather than to the total dose.

Effect on Disinfection. The bactericidal value of chlorine-ammonia treatment was determined by Race on the Ottawa River water in 1917. The adoption of this treatment for control of tastes and odors was followed by recognition of its disinfecting characteristics. Fourteen references in the bibliography offer data concerning laboratory and plant studies of the application of chlorine and ammonia for disinfecting purposes. Various investigators agree that the ultimate degree of disinfection accomplished by chlorine-ammonia treatment is equal to or superior to that effected by chlorination. The conditions of its use, however, must be somewhat more limited.

Contact time required for an equivalent degree of bactericidal

effect is longer for chlorine-ammonia treatment than for chlorine alone. It appears that two hours is the minimum length of contact period required for satisfactory results. The killing velocity decreases with a decrease in temperature and with an increase in the pH value of the water. While the efficiency of disinfection is lowered by increased turbidity, results with the chlorine-ammonia method appear to be eventually superior to those with chlorine alone in such waters.

In addition to the fact that, given adequate contact time, chlorine-ammonia application will produce the desired degree of disinfection, it possesses a distinct advantage which chlorine does not have. The residual remaining after chlorine-ammonia application is lost very slowly and thus persists far into the distribution system. This effect may be secured by adding ammonia before, with, or following the application of chlorine. Insufficient data are presented to indicate the ratio of chlorine to ammonia required for this purpose under any given conditions. There is some evidence that excess ammonia is frequently utilized by biologic growths.

Cost Data. There are 17 references to cost data in the bibliography but because they are so differently determined, no exact conclusions can be drawn. Early in the adoption of this method it was usual to consider satisfactory a chlorine-ammonia residual of the same value as a previously satisfactory chlorine residual. Such a residual could be produced with a lower chlorine dose because of the greater persistence of chlorine when combined with ammonia. Frequently, therefore, the total cost of a lower chlorine dose plus a small ammonia dose was reported as slightly lower than that of a higher chlorine dose.

This concept was soon changed, however, when it was realized that the lag in disinfection required the maintenance of higher residuals by the addition of higher original doses of chlorine and ammonia. Considered only on the basis of chemical addition, the cost of chlorine-ammonia treatment is higher than that of chlorine treatment. However, secondary benefits of this treatment may act to decrease this additional cost by improving plant operation. Also, if more effective disinfection is accomplished, the increase in cost appears well justified.

A Better Understanding of the Chlorine-Ammonia Method. It would be expected that an examination of the chlorine-ammonia

method in retrospect should disclose important considerations which would not be apparent at the time original investigations were made.

From a bacteriologic aspect, many of the early results reported are probably in error. Only more recently has the necessity for de-chlorination of samples prior to bacteriologic examination been recognized. Because disinfecting action of the added chlorine and ammonia may persist to the extent of introducing considerable error in such examinations, this must be considered when reviewing results that have been reported.

Even in its present state of application, the advantages of the chlorine-ammonia method have been indicated. The treatment appears suited to more successful adoption when it becomes better understood.

Extent of Use of Chlorine-Ammonia Treatment

In order to determine the extent of the use of chlorine-ammonia treatment of water throughout the United States, a questionnaire was mailed on March 1, 1938, to the various state sanitary engineers. In addition to data as to the number of supplies in a given state using chlorine-ammonia, the questionnaire requested essential information concerning methods of application, types of water supplies treated, residual-chlorine values maintained, chlorine-ammonia ratios employed, and any problems encountered in the use of the treatment. Questionnaires were returned from 36 states. The data which are compiled in Table 1 indicate that, in 1938, 2,541 public water supplies in the 36 states were treated with chlorine and that with 407 of these, or about 16 per cent, ammonia was used in conjunction with chlorine. Ratios of chlorine to ammonia employed varied from a maximum of 1:1 to a minimum of 12.8:1, averaging 3:1. The chlorine residuals maintained also varied widely from a maximum of 1.0 p.p.m. to a minimum of 0.01 p.p.m., averaging 0.25 p.p.m. The replies to these questionnaires stated in general that the use of chlorine and ammonia had been found effective. There was no indication that the treatment had failed in any appreciable number of instances to control taste and odor or to have a bactericidal effect. Thus it was apparent that the use of chlorine-ammonia treatment had been widely accepted and had become an important and efficient method for the production of water of satisfactory sanitary and aesthetic quality. Only three of the states indicated that chlorine-ammonia treatment was not used in any water supply.

TABLE 1

Regional Use of Chlorine-Ammonia Treatment of Water—Summary of Data From Questionnaire

STATE	NO. SUPPLIES TREATED WITH CHLORINE	NO. SUPPLIES TREATED WITH CHLORINE AND AMMONIA	RATIO OF CHLORINE TO AMMONIA			RESIDUAL CHLORINE VALUES			FACTORS CONTROLLED BY TREATMENT					
			Max.	Min.	Ave.	Max.	Min.	Ave.	Algae	Crenothrix	Taste and odor	Dead end taste and odor	Coliform micro-organisms	Gas-forming micro-organisms
Alabama	77	2	—	—	—	—	—	0.15	—	—	—	—	—	—
Arizona	14	4	—	—	2:1	—	—	0.20	Somewhat	Apparently	Yes	Aids	Yes	—
Arkansas	42	3	—	—	2:1	0.35	0.10	0.20	Yes	Yes	—	—	Yes	Yes
California	190	35	1.5:1	5:1	2.5:1	1.00	0.20	0.30	Yes	—	—	Yes	Yes	Yes
Colorado	23	7	1:1	3:1	2:1	0.30	0.10	0.20	—	—	Helps	Helps	Yes	Yes
Connecticut	101	11	2:1	12:1	4:1	0.40	0.10	0.25	No	—	Partial	Partial	Yes	If high enough
Delaware	4	0	—	—	—	—	—	—	—	—	—	—	—	—
Georgia	148	14	—	—	—	—	—	—	—	Some cases	Some cases	Yes	Yes	Yes
Idaho	12	4	3:1	6:1	4:1	0.15	0.08	0.12	No	No	Yes	Yes	Yes	No
Illinois	34	27	—	—	—	—	—	—	—	—	—	—	—	—
Indiana	87	17	3:2	5:1	3:1	0.50	0.20	0.30	No	Yes	No	Yes	Yes	Equal to chlorine
Iowa	94	9	—	—	—	0.80	0.10	0.30	Yes	Usually	Not uniform	—	Yes	No
Kansas	80	18	2:1	4:1	3:1	0.30	0.20	0.25	Yes	Yes	Yes	—	Yes	Yes
Kentucky	35	13	2:1	6:1	4:1	0.50	0.10	0.20	Somewhat	?	Yes	Yes	Yes	Yes
Louisiana	34	3	6:1	7:1	5.5:1	—	—	0.20	—	No data	—	—	Yes	Yes

Maine	95	5	3:1	6:1	4:1	0.30	0.10	0.20	Yes	Yes	Yes	Yes	Apparently			
Maryland	49	4	3:1	6:1	4:1	0.40	0.20	0.35	Yes	—	Yes	Yes	Yes	Yes		
Massachusetts	69	3	3:1	4:1	3:1	0.60	0.28	—	—	—	—	—	—	—		
Michigan	47	26	3:1	11:1	5:1	0.50	0.10	0.30	?	?	Yes	Yes	Yes	No		
Minnesota	17	5	—	—	3:1	0.80	0.35	0.40	Yes	Yes	Yes	Yes?	Yes	Yes		
Mississippi	15	1	—	—	—	0.50	0.20	0.35	—	—	Yes	Yes	Yes	Yes		
Missouri	255	10	—	—	4:1	—	—	0.30	?	?	*	Yes	Yes	No		
Montana	30	12	1.2:1	4.9:1	3:1	0.30	0.10	—	?	—	Yes	Considerably	Yes	Not altogether		
New Hampshire	34	0	—	—	—	—	—	—	—	—	—	—	—	—		
New Mexico	10	3	—	—	—	—	—	—	No	Possibly	?	?	Yes	No		
New York	197	69	2:1	6:1	3:1	0.60	0.15	0.30	Partial	Yes	Assists	Assists	Yes with contact	Yes with contact		
N. Carolina	116	21	—	—	3.5:1	—	—	0.30	Partial	Partial	Partial	Partial	Yes	Yes except spore-formers		
Ohio	110	17	—	—	3:1	0.60	0.01	—	—	—	—	—	Yes	Not entirely		
Oklahoma	84	11	—	—	3:1	—	—	0.20	Yes	Yes	Some	Yes	Yes	No		
Oregon	68	10	3:1	5:1	4:1	1.00	0.10	—	Yes in general	—	Yes in general	Helps	Yes	Yes		
Rhode Island	16	2	2.5:1	4:1	3:1	0.55	0.01	0.30	Yes	Yes	Yes	Yes	Yes	Usually		
Texas	56	6	—	—	—	—	—	—	Yes	—	Yes	—	Apparently			
Vermont	6	0	—	—	—	—	—	—	—	—	—	—	—	—		
Virginia	179	10	—	—	—	0.50	0.10	0.25	—	—	Yes	Yes	Yes	Yes		
Washington	80	13	1.75:1	4:1	3:1	0.20	0.10	0.15	—	—	Yes	—	Yes	Yes		
Wisconsin	33	12	2.8:1	12.8:1	5.7:1	0.35	0.10	0.20	?	—	—	—	Yes	No		

* If due to phenols, yes; otherwise, no.

Questionnaires and data were not received from the following states: Florida, Nebraska, Nevada, New Jersey, North Dakota, Pennsylvania, South Carolina, South Dakota, Tennessee, Utah, West Virginia and Wyoming.

Conditions Affecting the Formation of Chloramines—
A. E. Griffin*

Chlorine-ammonia treatment is based on the premise that when chlorine and ammonia are added to water in certain ratios, chloramines will be formed. According to Chapin (1) and others this ratio should be 4:1 at pH 8.5 and 8:1 at pH 4.5. Ratios between these extremes should vary in relation to the pH value. In practice, ratios of 3:1 or 4:1 seem to have met with the greatest favor although ratios of as high as 12.8:1 have been used. In a few instances good results have been obtained by applying the chlorine and ammonia in a 1:1 ratio. Occasionally such unusual effects have been noticed that a few authors have at times felt that with the concentrations of ammonia encountered in water works practice, other reactions than those associated with the formation of chloramines must occur.

Uncertainty as to the formation of chloramines at the concentrations ordinarily encountered in water works practice has been intensified by the fact that Chapin worked with concentrations of from 1,000 to 2,000 p.p.m. chloramines, concentrations never attained in practice. Where such amounts are present, it is relatively easy to recover both mono- and di-chloramines by absorption. Throughout this early experimental work, the necessity of excess ammonia for the efficient production of chloramines was stressed.

When chlorine is added in excess of the ammonia, the formation of chloramines appears to be influenced by many factors. At the lower concentrations of 1 p.p.m. or less, the concentrations more frequently found in practice, recovery of chloramines is not possible.

Griffin and Chamberlin indicate†, however, that chlorine may combine with ammonia to form chloramines according to the equations propounded by Chapin and others.

$$NH_3 + Cl_2 \rightarrow NH_2Cl + HCl$$
$$NH_3 + 2Cl_2 \rightarrow NHCl_2 + 2\ HCl$$

In this work the effect of chlorine on ammonia nitrogen was studied at pH values of 5.0, 6.0, 7.0, 8.0, and 9.0, and under controlled conditions in the absence of interfering substances. The chlorine was added in equal increments from 0 to 11 p.p.m. The amount of ammonia nitrogen present at the start of each test was 0.5 p.p.m.

* Sanitary Engineer, Wallace & Tiernan Co., Inc., Newark, N. J.

† Griffin, A. E. and Chamberlin, N. S. Some Chemical Aspects of Break-Point Chlorination. J. N. E. W. W. A., **55**: 371 (1941).

This was deemed sufficient to allow for accurate analysis, yet low enough to approximate plant practice. Chlorine residuals were determined at the end of 20-minute, 2-hour, and 24-hour periods of contact and ammonia residuals at the end of the 2- and 24-hour periods.

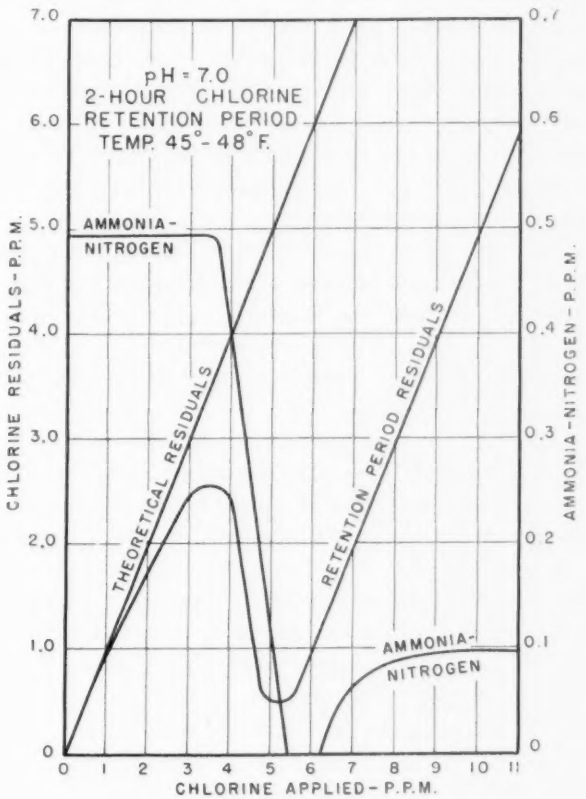

FIGURE 1

Figure 1 illustrates the ammonia and chlorine residuals at the end of the 2-hour period of contact at pH 7.0. Under the conditions of this experiment there was little, if any, loss of ammonia until chlorine had been added in excess of that theoretically required to combine with the ammonia present to form chloramines. Beyond this point (about 3.5 p.p.m. chlorine as shown in Fig. 1) other reactions took place, resulting in a marked decrease of ammonia at the

point where the concentration of chlorine reaches a minimum. Beyond this point the chlorine residuals increased roughly in proportion to the chlorine applied. It is in this region, where chlorine is in excess of that theoretically necessary to form the chloramines, that the reactions referred to as belonging to the "break-point" group take place.

Throughout the work there were indications that the residuals within the "hump" area (0.0–5.5 p.p.m. chlorine as in Fig. 1) were due to chloramines, or some combination of chlorine and ammonia, and not to chlorine alone. There were further signs that beyond the "break" (beyond 5.5 p.p.m. as in Fig. 1) chlorine residuals alone prevailed. That such was the case was indicated by indirect methods, inasmuch as it is impractical to isolate chloramines by absorption at such low concentrations.

One of the simplest methods of identification is to observe the speed of the production of color with ortho-tolidine following its addition to water. Another method is to treat the sample containing the chloramines with an amount of sodium nitrite equivalent to the chlorine present, followed within 30 seconds by the addition of ortho-tolidine (2). Where the residual is made up largely of chloramines, or some combination of chlorine and ammonia, there will be little difference between the color developed after treatment with the nitrite, and the untreated sample. Where the residual is primarily due to chlorine alone, the sample treated with sodium nitrite will show very little if any yellow color. Both of the tests were applied to the series of samples shown in Fig. 1. Here the color development with ortho-tolidine alone was very slow in the region of the "hump" part of the curve and very rapid beyond the point of minimum residuals. Furthermore, treatment with nitrite had little effect on the residuals within the "hump" area although such treatment completely removed the residual beyond the break. These tests lead to the conclusion that the residuals first formed following the application of chlorine to a water containing ammonia nitrogen are due to chloramines and that those formed beyond the "break-point" are due to the presence of chlorine alone.

By accepting this evidence that combinations of chlorine and ammonia are present in the "hump" part of the curve and chlorine alone beyond the "break-point" it can further be assumed that mono-chloramines are formed at approximately pH 8.5 and di-chloramines at pH 4.5 or 5.0. For instance, according to the equa-

tion for the formation of mono-chloramines, ($NH_3 + Cl_2 \rightarrow NH_2Cl + HCl$) the addition of 2.5 parts of chlorine to a water sample at pH 8.5 or above, and containing 0.5 p.p.m. nitrogen, would be just sufficient to react with the nitrogen for the formation of mono-chloramine. On the other hand, according to the equation for the formation of di-chloramines ($NH_3 + 2\ Cl_2 \rightarrow NHCl_2 + 2\ HCl$), 5.0 parts of

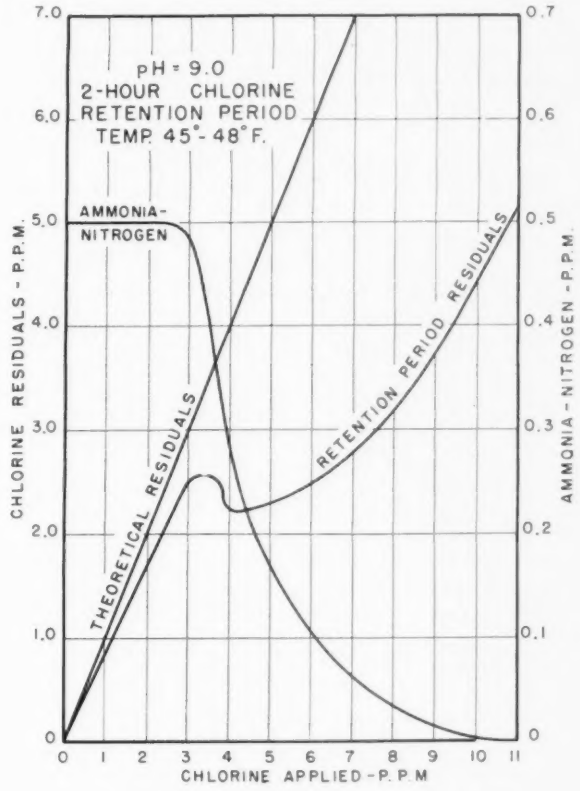

FIGURE 2

chlorine would be required to react at pH 4.5 or 5.0 with the same amount of nitrogen to form di-chloramines.

In Fig. 2, at pH 9.0, the maximum residual prior to any loss of ammonia prevails following the application of from 2.5 to 3.0 p.p.m. chlorine, whereas at pH 5.0, as shown in Fig. 3, nearly twice this amount of chlorine was applied before the ammonia began to recede.

Since the residuals within these applications of chlorine have conformed to several tests for chloramines, and since the amounts of chlorine used so nearly approximated the theoretical amounts required for the formation of chloramines, it seems reasonable to conclude that mono- and di-chloramines are formed at these con-

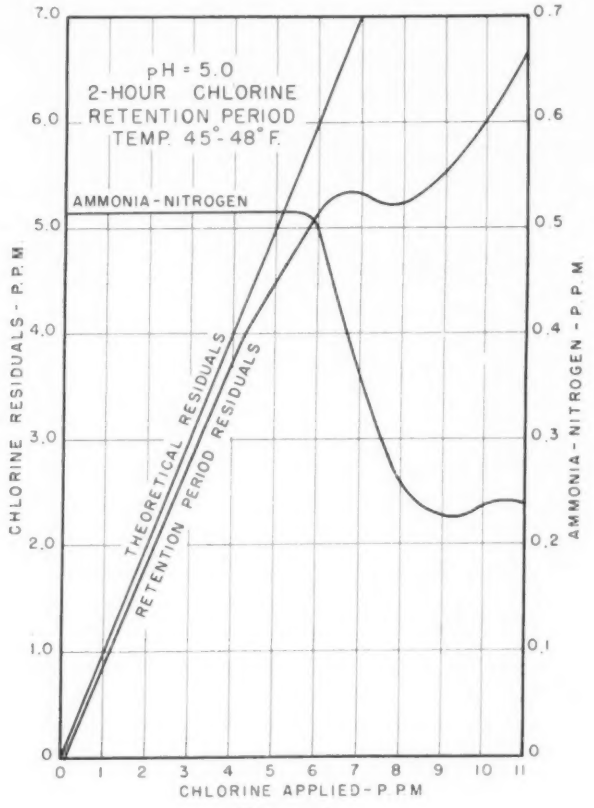

FIGURE 3

centrations at approximately pH 5.0 and 9.0, which is in accord with Chapin's work.

Until very recently it has been the practice when using the chlorine-ammonia process to add sufficient ammonia to insure a definite excess. By so doing it is now known that various relatively stable chloramines are formed. When chlorine has been added in excess unaccountable reactions have occurred. In the series of experi-

ments undertaken by the Committee, the cause of such a phenomenon was explained as shown in Fig. 1 where both ammonia and chlorine were materially reduced when the ratio of ammonia nitrogen to chlorine approached 1:10. This point is currently referred to as the "break-point." It is just beyond this point where tastes and odors will be at a minimum and where it is difficult for bacteria to survive (3). The extent of this "dip" will depend both upon time

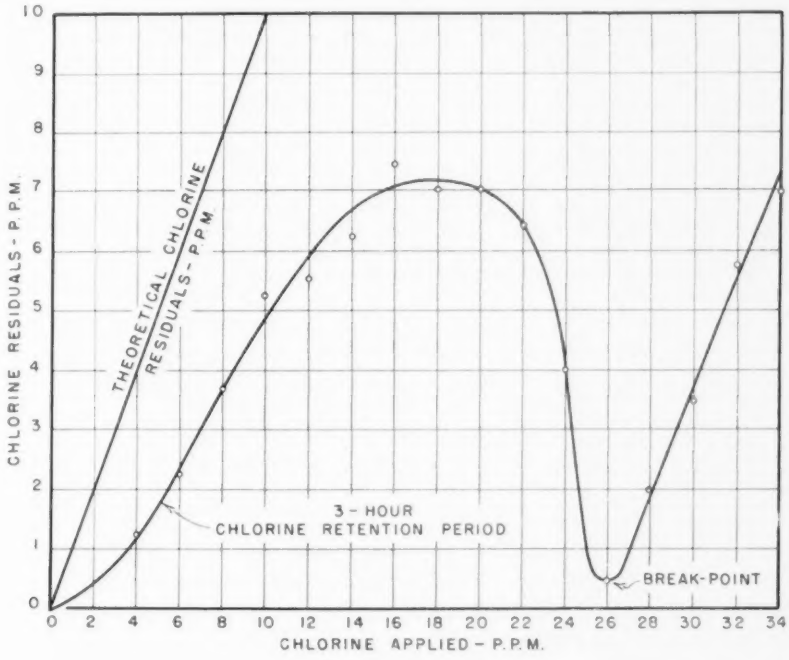

FIGURE 4

of contact and the pH of the solution. At pH 5.0 and 6.0 minimum losses in chlorine and ammonia will occur while maximum losses will be obtained at pH 7.0, 8.0, and 9.0 provided contact times of at least 30 min. are allowed.

As a result of this work it is possible to exercise more complete technical control over chlorine-ammonia treatment of water. Conformance to certain ratios of chlorine and ammonia will result in formation of chloramines, or, if desired, ammonia can be eliminated from the sphere of action. Each has its advantages.

TABLE 2

Comparative Effect on Persistence of Residual Chlorine Using Various Sources of Ammonia for Formation of Chloramines

(0.5 p.p.m. Chlorine and 0.4 p.p.m. NH_3 Applied)

Tests made under J. R. Baylis at Experimental Filtration Plant Feb. 1931

TIME AFTER APPLICATION OF CHEMICALS	RESIDUAL CHLORINE IN WATER (ORTHO-TOLIDINE METHOD) IN P.P.M.																	
	Low Temperature (0°–3°C.)						Medium Temperature (9°–12°C.)						Room Temperature (19°–22°C.)					
	Chlorine only	$Cl_2 + NH_4Cl$	$Cl_2 + Al(NH_4)(SO_4)_2 12H_2O$	$Cl_2 + (NH_4)_2SO_4$	$Cl_2 + NH_4OH$	$Cl_2 + (NH_4)_2CO_3$	Chlorine only	$Cl_2 + NH_4Cl$	$Cl_2 + Al(NH_4)(SO_4)_2 12H_2O$	$Cl_2 + (NH_4)_2SO_4$	$Cl_2 + NH_4OH$	$Cl_2 + (NH_4)_2CO_3$	Chlorine only	$Cl_2 + (NH_4)Cl$	$Cl_2 + Al(NH_4)(SO_4)_2 12H_2O$	$Cl_2 + (NH_4)_2SO_4$	$Cl_2 + NH_4OH$	$Cl_2 + (NH_4)_2CO_3$
5 min.*	0.35	0.50	0.50	0.50	0.50	0.50	0.35	0.50	0.50	0.50	0.50	0.50	0.40	0.50	0.50	0.50	0.50	0.50
30 min.	0.30	0.50	0.50	0.50	0.50	0.50	0.30	0.50	0.50	0.50	0.50	0.50	0.25	0.45	0.45	0.45	0.45	0.45
2 hr.	0.25	0.45	0.45	0.45	0.45	0.45	0.25	0.45	0.45	0.45	0.45	0.45	0.10	0.45	0.45	0.45	0.45	0.45
24 hr.	0.05	0.30	0.40	0.40	0.40	0.40	0.05	0.40	0.40	0.40	0.40	0.40	Tr.	0.45	0.45	0.35	0.40	0.40
48 hr.	Tr.	0.10	0.40	0.35	0.40	0.40	Tr.	0.40	0.40	0.40	0.40	0.40	Tr.	0.40	0.35	Tr.	0.35	0.35
96 hr.	Tr.	0.10	0.40	0.35	0.40	0.40	0	0.40	0.40	0.40	0.40	0.40	Tr.	0.35	0.30	Tr.	0.35	0.35
120 hr.	Tr.	0.05	0.40	0.35	0.40	0.40	0	0.35	0.35	0.35	0.35	0.35	0	0.35	0.15	0	0.30	0.35

* Methyl orange alkalinity, 122 p.p.m.; pH, 7.8; turbidity, 7 p.p.m.
Tr. = trace.

TABLE 3

Comparative Effect on Persistence of Residual Chlorine Using Various Sources of Ammonia for Formation of Chloramines

(1.0 p.p.m. Chlorine and 0.5 p.p.m. NH_3 Applied)

Tests made under J. R. Baylis at Experimental Filtration Plant March 1931

TIME AFTER APPLICATION OF CHEMICALS	RESIDUAL CHLORINE IN WATER (ORTHO-TOLIDINE METHOD) IN P.P.M.																	
	Lowest Temperature (0°–2°C.)						Medium Temperature (10°–12°C.)						Room Temperature (20°–22°C.)					
	Chlorine only	Chlorine and NH_4Cl	$Cl_2 + Al(NH_4)(SO_4)_2 12H_2O$	$Cl_2 + (NH_4)_2SO_4$	$Cl_2 + NH_4OH$	$Cl_2 + (NH_4)_2CO_3$	Chlorine only	$Cl_2 + NH_4Cl$	$Cl_2 + Al(NH_4)(SO_4)_2 12H_2O$	$Cl_2 + (NH_4)_2SO_4$	$Cl_2 + NH_4OH$	$Cl_2 + (NH_4)_2CO_3$	Chlorine only	$Cl_2 + NH_4Cl$	$Cl_2 + Al(NH_4)(SO_4)_2 12H_2O$	$Cl_2 + (NH_4)_2SO_4$	$Cl_2 + NH_4OH$	$Cl_2 + (NH_4)_2CO_3$
5 min.*	0.60	0.60	0.60	0.65	0.65	0.65	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.65	0.65	0.65	0.65	0.65
30 min.	0.40	0.60	0.60	0.65	0.65	0.65	0.45	0.60	0.60	0.60	0.60	0.60	0.40	0.65	0.65	0.65	0.65	0.65
2 hr.	0.30	0.65	0.65	0.65	0.65	0.65	0.30	0.65	0.65	0.65	0.65	0.65	0.05	0.60	0.60	0.60	0.60	0.60
24 hr.	Tr.	0.55	0.60	0.60	0.60	0.65	Tr.	0.55	0.55	0.55	0.55	0.55	0	0.40	0.40	0.40	0.45	0.45
48 hr.	0	0.55	0.60	0.60	0.60	0.65	0	0.55	0.55	0.55	0.55	0.55	—	0.30	0.25	0.15	0.30	0.30
72 hr.	0	0.50	0.55	0.55	0.55	0.55	—	0.45	0.55	0.45	0.45	0.40	—	0.20	0.25	Tr.	0.25	0.25
96 hr.	—	0.50	0.55	0.55	0.55	0.50	—	0.40	0.55	0.40	0.40	0.40	—	0.05	0.10	Tr.	0.10	0.10
120 hr.	—	0.55	0.55	0.50	0.55	0.50	—	0.35	0.50	0.45	0.45	0.50	—	Tr.	Tr.	0	0.05	Tr.

* Methyl orange alkalinity, 120 p.p.m.; pH, 7.6; turbidity, 104 p.p.m.
Tr. = trace

Natural Ammonia Nitrogen in Water and the Formation of Chloramines—*A. E. Griffin*

Repeated statements have been made over a period of years that chlorine will combine with the natural free ammonia in water to form chloramines, while others have expressed some doubt as to the possibility of any such combinations, particularly in the concentrations ordinarily encountered. Neither side, however, has presented convincing data supporting its beliefs. In 1940 Calvert (4), however, presented data indicating that the amount of chlorine required to reach the "break-point" is a function of the amount of ammonia present. At about the same time it was found that there is little if any loss of ammonia up to the top of the "hump" of the curve. These observations coupled with field experiences wherein the "break-point" curve varied with the natural ammonia content had led to the conclusion that chlorine will form chloramines with the natural ammonia nitrogen present. Figure 4 is offered as an example of a curve resulting from the chlorination of a water containing free ammonia.

Comparative Value of Various Sources of Ammonia for Formation of Chloramines—*H. H. Gerstein**

There has been some difference of opinion concerning the relative merits of anhydrous ammonia and its various compounds in the formation of chloramines. In February and March 1931, Baylis carried out an investigation at the Experimental Filtration Plant in Chicago, using ammonium chloride, ammonium alum, ammonium sulfate, ammonium hydroxide, and ammonium carbonate. The experiments were conducted in triplicate, the first portion being kept at low temperature (0° to 3°C.), the second portion at a medium temperature (9° to 12°C.), and the third portion at room temperature (19° to 22°C.). Residual chlorine tests were made at intervals by means of the ortho-tolidine method. The results of these tests shown in Tables 2 and 3 indicate that for the same temperature, there is no marked difference, especially during the first 24 hours after application, in the effect of the various sources of ammonia on the persistence of residual chlorine. Apparently, temperature is a major influence in the disappearance of the residual chlorine values.

Fate of Ammonia in Distribution Systems—*A. E. Griffin*

Evidence is somewhat meager concerning the fate of ammonia in the distribution system. No really authentic data have been

* Sanitary Engineer, Dept. Public Works, Chicago.

submitted verifying the possibility of an ammonia demand of certain waters. Undoubtedly where it is added far enough ahead of chlorination, there may be some loss in ammonia. Reliable data, however, are rare, possibly because of difficulties with the test for ammonia nitrogen. There is some evidence that the ammonia content will remain in the mains at a fairly constant level so long as residual chlorine persists. In one instance where residual chlorine did not exist there was a sharp decrease in ammonia nitrogen accompanied by a rise in the nitrate content (see Table 4). Evidence is too

TABLE 4

Fate of Nitrogen in Distribution System

DATE	STATION	AMMONIA-CHLORINE RATIO	CHLORINE DOSAGE	RESIDUAL CHLORINE (ORTHO-TOLIDINE)	NITROGEN AS		
					Free ammonia	Nitrite	Nitrate
			p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m*
2/3/1937	Raw	1:7	0.48	0.03	0.010	0.000	0.03
	Gate-house			0.28	0.060	0.000	0.03
	Quin. & Essex			0.20	0.058	0.000	0.05
	#42			0.14	0.056	0.000	0.05
	#41			0.15	0.052	0.000	0.06
	#33			0.00	0.018	0.000	0.07
2/10/1937	Raw	1:10	0.45	0.00	0.000	0.000	0.04
	Gate-house			0.19	0.022	0.000	0.04
	Quin. & Essex			0.19	0.036	0.000	0.04
	#42			0.13	0.030	0.000	0.04
	#41			0.11	0.032	0.000	0.04
	#33			0.00	0.000	0.000	0.08
2/25/1937	Raw	1:5	0.46	0.00	0.026	0.000	0.05
	Gate-house			0.20	0.066	0.000	0.05
	Quin. & Essex			0.20	0.066	0.000	0.03
	#42			0.15	0.062	0.000	0.05
	#41			0.15	0.052	0.000	0.06
	#33			0.00	0.004	0.000	0.07
3/10/1937	Raw	1:6	0.43	trace	0.002	0.001	0.04
	Gate-house			0.22	0.056	0.000	0.04
	Quin. & Essex			0.20	0.056	0.000	0.04
	#42			0.15	0.052	0.000	0.04
	#41			0.15	0.048	0.000	0.04
	#33			0.00	0.004	0.000	0.10

incomplete to permit conclusions relating to the prevalence of such conditions. Buswell (5) has indicated that ammonia nitrogen is one of the main sources of energy for the growth of bacteria within a distribution system. Granting such to be the case, it would appear that good operation and maintenance of quality of water within a distribution system would call for the complete eradication of ammonia nitrogen at the plant. Should this prove to be desirable, a method is at hand in the form of "break-point" chlorination.

Loss of Chlorine-Ammonia Residuals Through Aerators—*R. W. Fitzgerald**

Occasionally chlorine-ammonia treatment is required in advance of aeration and the fate of chloramine residuals following aeration has been in doubt. At Norfolk, Va., the effect of aeration on chlorine-ammonia treated waters has been studied. Both the step type and the riffle-board type of aerator have been used. Residuals entering the aerator were varied from 0.1 p.p.m. to 1.75 p.p.m. Ammonia-chlorine ratios varied from 1:3 to 1:15. The results of these experiments indicated that neither of the above methods of aeration would appreciably affect chlorine-chloramine residuals ranging up to 0.5 p.p.m., regardless of the ammonia-chlorine ratio used. Residuals ranging from 0.5 p.p.m. to 1 p.p.m. would be reduced approximately 20 per cent by either type of aerator. From 1 p.p.m. to 1.75 p.p.m. losses were sustained up to as much as 50 per cent with some ratios. Losses on residuals from 0.5 p.p.m. to 1.75 p.p.m. could be reduced to approximately 10 per cent by using a 1:4 ratio.

Taste and Odor Control

The use of chloramines in the treatment of water was first suggested as a means of controlling the chlorophenolic taste and odor conditions resulting from the addition of chlorine to water containing traces of phenols. The method has also found application in the control of other taste conditions resulting from the reaction of chlorine with organic matter in water. For adequate odor control it has been considered that the ammonia should be added first and when thoroughly mixed, chlorine added to provide for immediate formation of chloramines and the adsorption of the chlorine by the ammonia before it has had an opportunity to react with organic matter or other substances. The efficiency of the method lies in

* Chief Chemist, Div. of Water Supply, Norfolk, Va.

the limited oxidizing power of chloramines and in the slowness with which they react to form chloro-substitution products; thus the objectionable tastes and odors are not formed or are formed only slowly. With certain types of taste and odor conditions, particularly those described as earthy or musty, chlorine-ammonia treatment has not always been found satisfactory although the explanation is somewhat obscure. Recent observations of super-chlorination treatment indicate that chlorine may be added in advance of the ammonia to oxidize and destroy the taste-producing substances, the subsequent addition of ammonia reacting with the residual chlorine to eliminate chlorinous tastes. The use of chloramines, particularly because of the persistence of residuals in distribution systems, has been found very effective in the control of hydrogen-sulfide production or other obnoxious tastes and odors in the distribution systems presumably by controlling growths of bacteria. Although chlorine-ammonia treatment has been found generally effective in the control of tastes and odors in water supplies, its application to any individual problem must be studied carefully in relation to the particular conditions pertaining in order that the method of treatment and the concentration of the two chemicals necessary for satisfactory results may be determined.

Bactericidal Value of Chloramines

Evidence from the field indicates that chloramines are generally successful in the disinfection of water supplies. In practically every case reported to the Committee the process has eliminated microorganisms of the coliform group. Regarding the effectiveness of the process in the control of gas-forming bacteria not confirmed as of the coliform group, however, there appears to be some uncertainty. In turbid raw waters, such as prevail at Atlanta, and Athens, Ga., and Charlotte, N. C., there are indications that these troublesome gas-forming bacteria are eliminated following chlorine-ammonia treatment of the raw water. Treatment at that point is sometimes so effective that post-chlorination is unnecessary. However, post-chlorination provides an essential "factor of safety" of treatment unobtainable in any other manner. In regions where fairly clear waters are encountered, chlorine-ammonia treatment may not be fully effective for the removal of the gas-forming bacteria. In one plant a year's operating records show that these microorganisms persisted even in the presence of a substantial chloramine

residual. Over the 55 recorded analyses, the temperature ranged from 36° to 69°F.; chlorine added ranged from 10 lb. to 37 lb. and ammonia from 3.5 lb. to 9.8 lb., with a residual of from 0.08 p.p.m. to 0.35 p.p.m.; and the per cent showing gas varied from 5 to generally as high as 30, with one 40, one 50 and one 70. Only one-sixth of the analyses showed confirmation on eosin methylene blue. Ammonia and chlorine were applied to the raw water followed by pressure filtration with alum coagulation and storage in a covered reservoir. It is possible that this condition might be amenable to improvement by changes in operation.

Unfortunately the Committee was not able to obtain data based on extensive research regarding the fundamental principles underlying the bactericidal properties of chloramines. The rate of bactericidal action is much slower than that of chlorine and thus to obtain the desired disinfection results it is necessary to provide a sufficiently high dose and a sufficiently long contact time to accomplish these results. Only by routine bacteriologic tests can the effectiveness of the dose and contact time provided be assured. In general, it has been found in chlorine-ammonia treatment that a 2-hour reaction period before the treated water reaches the consumer, and maintenance of residuals at least twice the concentration found desirable when chlorine alone is used, will provide effective treatment.

The hydrogen-ion concentration of the water exerts a marked influence on the bactericidal characteristics of chloramines, but this phase of the problem also requires more complete investigation. The tendency of chlorine to react with organic matter and other reducing substances in water supplies to form adsorption compounds or organic chloramines of uncertain bactericidal value has been one of the major problems in the control of the disinfection action of this chemical. Because of the greater affinity of chlorine for ammonia, the chlorine, when added to water subsequent to treatment with ammonia, tends to form inorganic chloramines and thus is not adsorbed immediately by organic matter. The reduced rate of disinfection by chloramines is occasioned by the lowered oxidation-reduction potentials which in turn retard their adsorption by organic matter. However, it is probable that the chloramines will be absorbed by non-living organic matter as by bacteria but at the same reduced rate. Thus the maintenance of disinfecting chlorine residuals in the treated water can be continued for a longer period than

with chlorine alone, permitting the carrying of such residuals to more remote sections of reservoirs and distribution systems. This is another phase of the study of the value of chlorine-ammonia treatment which requires further investigation and upon which more extensive experimental data are needed. The recent studies of Mallmann and Ardrey (6) of the relationship of oxidation-reduction potentials to the germicidal functions of chlorine suggest that much valuable information can be obtained by similar studies applied to chloramines.

Without a doubt one of the principal values of chlorine-ammonia treatment lies in the persistence of a significant chlorine residual value in the treated water. These residual values persisting in distribution systems, reservoirs, and other parts of a water supply aid materially in the maintenance of satisfactory bacteriologic conditions. Experience at Poughkeepsie, N. Y., is typical of the instances which illustrate the value of this property. Aftergrowths had appeared regularly in the distributing reservoirs of this plant each summer for several years. Repeated attempts had been made to carry residuals into these reservoirs with chlorine alone without much success because of the production of chlorinous tastes as soon as residuals were increased sufficiently to penetrate into the system for any appreciable distance. Early in the summer of 1936 experiments were inaugurated to test the ability of ammonia to carry a residual to these reservoirs. It was found that a 3:1 ratio of chlorine to ammonia would produce a residual of 0.1 p.p.m. at the reservoir. Within a week after the process was installed the troublesome bacterial aftergrowths disappeared.

In the use of chlorine-ammonia for disinfection the problem of the proper ratio of chlorine to ammonia is always pertinent. As indicated by the results of the questionnaire the usual ratios employed are 3:1 and, in general, satisfactory results have been obtained with their use. However, available data indicate that for a given chlorine residual the sterilizing activity of the treatment is increased with a decrease in the proportion of ammonia used. Without doubt other conditions in the water treated also influence the extent of sterilization. Experiences in the use of extreme ratios are typified by the following instances: At Bound Brook, N. J., chlorine and ammonia have been applied continuously to the raw water since the completion of the plant in 1931, the ratios having been maintained very

close to 3:1. This treatment, together with excellent water conditioning and floc formation, has resulted in a coliform index of the filter influent of approximately 3.0 per 100 ml. In an effort to bring about some improvement in operation during the summer of 1936, it was decided to study the effect of a chlorine-ammonia ratio of approximately 6:1. At this time the coliform index was very nearly the figure given above, and occasional gas-forming bacteria were passing through the filters. Within a week after the inauguration of the new ratio, the index had dropped to around 0.3 and the passage of gas-forming bacteria through the filters had practically ceased. The supply at High Bridge, N. J., is a small one of about 200,000 gal. per day capacity. The water is unfiltered and feeds by gravity directly to the consumers from a concrete-lined service reservoir of about 750,000 gal. capacity. Chlorine and ammonia had been applied to the inlet of this reservoir in quantities sufficient to give a residual of at least 0.2 p.p.m. at the outlet, which was intended to give a residual of 0.1 p.p.m. at the taps in town. In spite of this, a significant number of samples collected for bacteriologic analysis showed gas-forming micro-organisms, some of which confirmed as members of the coliform group. After several weeks of experimenting with varying doses, it was found that applying the chlorine and ammonia in a ratio of approximately 12:1 gave satisfactory bacteriologic results. These three examples indicate the desirability of considering carefully the chlorine-ammonia ratio in order to secure the full benefits of the process.

The order of application of the two chemicals, in either filtered or unfiltered supplies, has, of course, a marked effect on the bactericidal results. Thus, as indicated above, when ammonia is added in advance of chlorine, combinations of chlorine and ammonia are formed, with a resulting decrease in the rate of bacterial destruction. If minimum residual values are maintained, adequate bactericidal action frequently does not result and, as was demonstrated above, coliform micro-organisms are found in the treated water. To obtain more complete and rapid disinfection, which should be accomplished whenever practicable, the chlorine should be added first. After a reaction period essential to secure adequate bactericidal effect, ammonia may be added in sufficient concentration to combine with the existing residual chlorine.

With unfiltered water supplies, it is imperative that the destruc-

tion of micro-organisms be as complete and rapid as possible. Thus the addition of chlorine in advance of ammonia is of particular importance especially where chlorination is the sole treatment for the production of potable water. If the chlorine is added first, a more rapid bactericidal effect can be relied upon, while the subsequent addition of ammonia will provide chloramines for the maintenance of residual chlorine in the distribution system. This order of application is preferable except in those instances where serious taste and odor conditions must be eliminated by the immediate formation of chloramines or where ammonia is added in advance of chlorine to induce "break-point" reactions which have proven efficacious in the removal of tastes, odors and bacterial pollution.

In filter plants, disinfection of the raw water, with chlorine alone, prior to conditioning and filtration, is preferable to the use of ammonia and chlorine. Bacteria are removed in an early stage of the purification process, thereby relieving the load on the filters, which in highly polluted waters provides a more positive treatment. Current experiences with super-chlorination, or "break-point" chlorination, indicate that superior bactericidal results can be obtained by the addition of sufficient chlorine alone to the raw water to produce a residual in the filter influent, and possibly also in the effluent. Subsequent treatment of the filtered water with chlorine and ammonia will provide for carrying effective residual chlorine into the distribution system. This latter treatment is facilitated by the removal of chlorine demand and by the oxidation of any natural ammonia as a result of the raw water treatment.

Pipe Line Capacities—*A. E. Griffin*

Long transmission mains and practically all the piping in any water works system are subject to slime growths, the extent of which depends upon the source of supply, the completeness of purification, and the residual chlorine values maintained. Such growths become of considerable economic importance in transmission mains, for they may reduce the carrying capacity of the line to the point where pumping costs become excessive or duplicate lines must be laid.

In several instances chloramines have proved very beneficial, notably so at Utica, N. Y., where the application of chlorine and ammonia at the inlet of a 12-mile steel pipe maintained the carrying capacity practically constant (7).

Reducing Pipe Line Friction Losses With Chloramine Treatment—*Marion L. Crist**

Early in 1938 the City of Little Rock, Ark., completed a new water supply. Included in this supply is a pipe line, 35 mi. long and 39 in. in internal diameter, carrying impounded surface water from a newly created lake to the city. The line is constructed of steel cylinder reinforced concrete pipe as manufactured by the Lock Joint Pipe Company of Ampere, N. J.

The lake water transported in this line is an extremely soft surface water more or less typical of the runoff from the wooded sandstone and shale watersheds of the Ouachita Mountains in Arkansas. A typical analysis shows a total hardness of 12 to 15 p.p.m., nearly all in the form of calcium carbonate, a chloride content of 4 p.p.m., a a slight trace of iron, and a pH of 6.8. The watershed supplying the lake is entirely uninhabited, and the lake itself is deep. Therefore, bacterial pollution is negligible, and no difficulty with algae in the lake has been experienced.

This supply was placed in service on February 17, 1938. Shortly thereafter, on April 25, 1938, the pipe line was tested to determine its carrying capacity and its coefficient, C in the Williams-Hazen formula. At that time the line was found to be capable of delivering 25.32 m.g.d. to an emergency reservoir in the edge of the City. The average C for the line from the lake to the junction of the emergency reservoir line, a distance of 28.5 mi., was found to be 147. The remainder of the line beyond this junction was not and has not subsequently been included in the tests or experimental work because of the difficulty of wasting excess flows at the filtration plant when the line is opened to its full capacity. Unfortunately in this earliest test the line was not divided into sections. Only the average C for the full 28.5 mi. was determined.

Organic Growth in Line. Almost a year later, on February 23, 1939, the section of the line from the lake to the junction was again tested, and it was discovered that the capacity of the line had reduced to 20.38 m.g.d., and the average C had reduced to 120. A portion of the line was immediately dewatered and inspected. An organic slime growth was found to exist on the walls of the pipe, and this growth varied from practically no thickness in some loca-

* Engineer for the Little Rock, Ark., Municipal Water Works.

tions to more than a quarter of an inch in others. The growth was dark, almost black in color, and was interspersed with iron oxide, giving the mass a rusty to black appearance. The growth did not adhere tightly to the pipe walls because the pipe could readily be scraped clean with the bare fingers.

Studies of this growth made in the laboratory of Wallace and Tiernan indicated that three types of organisms predominated: large capsulated bacteria; a smaller capsulated form; and the iron bacteria, *Crenothrix*.

TABLE 5

Results of Pipe Line Treatment on Little Rock 39-Inch Concrete Pipe

TEST SECTION	LENGTH IN FEET	WILLIAMS-HAZENS "C" AS DETERMINED AT DIFFERENT DATES					
		Feb. 23* 1939	May 25* 1939	July 31 1939	Aug. 11 1939	Sept. 25 1939	Apr. 3 1940
1†	1,315	98	88	84	82	77	159
2	7,113			128	128	119	108
3	17,483			110	113	113	118
4	34,141	113	120	122	121	125	129
5	29,595	121	123	133	128	125	129
6	29,425	137	136		140	142	143
7	31,214	131	131	135	137	136	145
Average "C" for Total Length.....		120	120	128	128	129	133

* These results are before chloramine treatment, which was started on June 2, 1939.

† Section 1 is between the Intake Tower in the Lake and the point of application of chlorine-ammonia. It does not, therefore, benefit from chloramine treatment. It was treated on August 2, 1939, with 50 p.p.m. of copper sulfate and again on October 2, 1939, with 30 p.p.m. of chlorine.

These organisms have frequently been found to cause trouble in paper mills. While they are present in practically all surface waters, and sometimes in shallow wells, they usually do not proliferate sufficiently to be a nuisance in water supplies, probably because of lack of food. In a few instances, however, notably at Utica, N. Y., Longview, Texas, and now at Little Rock, Ark., they have flourished on the interior of long transmission mains to such an extent as actually to reduce the carrying capacity of those mains.

Prior to the discovery of this growth in the line at Little Rock,

the City had practiced sterilization of its water supply at the filtration plant in the City through the use of chlorine alone. Some tastes and odors had resulted which had been removed by the use of activated carbon. It had, however, been determined that tastes and odors could usually if not always be eliminated by using ammonia in conjunction with chlorine.

Institution of Chlorine-Ammonia Treatment. With the discovery of this growth it was decided to transfer the sterilization to a point near the lake and, in order to control tastes and odors as well as to permit the carrying of a residual sterilizing agent throughout the line, to use both chlorine and ammonia. Table 5 shows the results of this treatment. Before beginning such treatment the line was divided into seven test sections and the C for each section determined. These sections are numbered from the lake to the junction between the main pipe line and the branch line serving the emergency reservoir. Section 1 is from the intake tower in the lake to the point of application of the chlorine-ammonia. Section 2 is the first 7,113 ft. below the point of application; Section 3 the next 17,483 ft., etc. It is important to note that Section 1 is above the point of treatment with chlorine-ammonia and does not benefit from that treatment.

Two tests made prior to the beginning of the treatment indicated that the growth was greatest near the lake and became progressively less as the distance from the lake increased. Immediately below the lake the coefficient had dropped to well below 100, whereas twenty miles from the lake it was still above 130. In no section, however, was the coefficient as high as 147 which had been the average for the entire line when first placed in operation.

Chloramine treatment was started on June 2, 1939. During the first three weeks of treatment the chlorine dosage was varied slightly but in general was 1.26 p.p.m., and the ammonia was held at one-third of the chlorine. During this period the residual reaching the filtration plant in the city remained rather consistently at 0.55 p.p.m., and no tastes or odors were encountered. At the end of three weeks the capacity of the line as a whole had increased from 20.3 to 21.8 m.g.d., but no determinations of C for the various sections were made.

During the next month of treatment the ammonia was reduced to 15 per cent of the chlorine, without changing the chlorine dosage. At these dosages the residual at the filtration plant remained un-

changed at 0.55 p.p.m., but any further reduction in ammonia resulted in a reduction of this residual. No tastes or odors were encountered during this period. A full flow capacity test on July 31 showed no further increase in carrying capacity during the period, but determination of *C* by sections showed a marked improvement in the two months of treatment, with the greatest improvement being nearest the point of application.

Use of Copper Sulfate. At this time Section 1 was treated separately with copper sulfate. This section of line was only 1,315 ft. long, but the coefficient in it had dropped to 84 and some treatment seemed necessary.

The line was put back into service on August 4 and the chlorine-ammonia treatment continued with a chlorine dosage of 1.25 p.p.m. and ammonia at one-fourth of the chlorine. On August 11 tests indicated a gradual improvement in coefficients in the various sections being treated with chloramine, but there was no evidence of improvement in the short section treated with copper sulfate. On this date the chlorine dosage was increased to 1.6 p.p.m. and the ammonia held at one-fourth of the chlorine.

On August 14 strong chlorinous tastes and odors developed at the filtration plant. The chlorine dosage was reduced to 1.0 p.p.m. and the ammonia increased to one-third of the chlorine. Tastes and odors gradually disappeared thereafter over a period of three weeks. Since that time the chlorine dosage has consistently been held at 1.0 p.p.m. or slightly less with ammonia at one-third of the chlorine. Residuals at the filtration plant have tended to increase very gradually, but no serious tastes or odors have developed.

The line was tested again on September 25, 1939. The copper sulfate treatment of Section 1 had apparently had no result because the coefficient for this Section had further reduced to 77. Furthermore the chloramine treatment had failed to prevent a reduction in *C* from 128 to 119 in Section 2, although the rest of the line was slightly improved.

On October 2, 1939, Section 1 was treated with approximately 30 p.p.m. of chlorine and this solution was allowed to remain in the Section for two days. The entire line was then put back into operation and the normal chloramine treatment resumed.

Results. Finally on April 3, 1940, the line was again tested. The

maximum capacity had increased to 22.25 m.g.d. from the last previous flow of 21.8, which indicated a general improvement. The coefficient for Section 1 was above the average for the entire line when new, which indicated that this section had been effectively cleaned by the heavy chlorine treatment. The coefficient in Section 2, however, immediately below the point of application of chloramine, had dropped from 119 to 108. All other coefficients had increased slightly.

The reduction in carrying capacity in Section 2 in this final test may have been occasioned by either of two factors. Certainly a considerable amount of material sloughed off the walls of the pipe in Section 1 in order to improve the coefficient in that section to the extent indicated. Some of this material may have become lodged in Section 2 and so reduced its capacity. On the other hand, it may be possible that organisms capable of resisting the relatively low residuals carried in these experiments are developing in this section of line in spite of the chloramine treatment. In some cases considerably higher residuals than a fraction of one part per million have been found necessary to kill *Crenothrix*; for instance, the fact that the coefficient in this section reduced in each of the last two tests might seem to indicate the development of such growths.

The first of these two possibilities, however, appears most probable. Heavy flushing of this section did remove considerable amounts of organic material but without appreciably affecting the coefficient. Heavy flushing of the remainder of the line slightly affected coefficients, increasing some and reducing others. It is believed that this indicates the presence of dead organic matter in the line in sufficient quantity to affect the coefficients in the various sections.

In general chloramine treatment of this pipe line has restored approximately one-half the capacity lost by reason of the slime growth. The action of the small residuals used in this case seems to be very slow. Further experience may indicate the necessity of carrying higher residuals, although such practice may result in taste and odor problems. Chlorine alone in high concentrations appears to remove the growth quickly and effectively, which fact suggests that super-chlorination might be a more effective remedy than chloramine treatment.

The Use of Copper, Chlorine and Ammonia in Plankton Control—*C. K. Calvert**

The settling basin serving the slow-sand filter plant of the Indianapolis, Ind., water supply is 12 ft. deep with sloping sides and the retention period is from 36 to 48 hr. in mid-summer. Without inhibitive treatment the plankton grow rapidly in the clear water and reach proportions several times the content in the raw water. Local application of copper has been customary for many years.

When Harold (8) reported favorably on the continuous summer use of copper sulfate on incoming water in combination with chlorine and ammonia it was assumed that the combination of chemicals must suppress precipitation of the copper for a longer period, resulting in its continued action during the flow through the basin. Harold used 0.3 p.p.m. of copper and 0.25 p.p.m. of chlorine. To form cupric ammonium and di-chloramine with these amounts, 0.15 p.p.m. of ammonia are required. This treatment provided unsatisfactory plankton control under local conditions and the amounts were multiplied by ten, reductions being made from the maximum rates as conditions warranted.

Method of Chemical Feeding. At a point in the basin representing eight hours' detention, a chemical treatment plant was established consisting of (1) a chlorinator, (2) an ammoniator, (3) a dry feed machine for ammonium sulfate, and (4) a copper sulfate feeder of the Shelton type.

When anhydrous ammonia was used, the solution was added to the last compartment of the copper sulfate saturator, the copper going to the water as cupric ammonium sulfate. Ammonium sulfate, when used, was fed by a dry feed machine.

At the point of chemical application, the water was passed through an opening where the velocity was about 40 ft. per min. A piece of 8-inch pipe, 18 ft. long, was placed in the opening, parallel to the direction of the flow of water permitting a portion of the flow to pass through the pipe. Hose lines from the chemical feeders could be placed in the pipe at any point, varying the order in which the chemicals were added to the water.

Residual Copper. Residual copper was determined colorimetrically on samples of settled water filtered through hard paper. The

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amounts so obtained were about 70 per cent of those found in unfiltered samples. It would seem that copper at the effluent of the basin should be in the form of a precipitate since the pH is well above 7.0 and the alkalinity relatively high. Whether or not the residual copper is in solution has not been determined with certainty. It has been found that copper in distilled water at a pH below 6.0 (the critical point) is removed very completely by filter paper and more especially by asbestos if the contact time is long. Small copper concentrations persist in carbonate solutions even through centrifuging and react with the reagents in the test. It may be that such copper has an algaecidal action as well as copper in solution.

There was no substantial difference in the residual copper in the water leaving the basin, whether the ammonia was added in the form of ammonium sulfate or anhydrous ammonia and when no ammonia was added. Residual copper increased disproportionately with rates of feed. At 1 p.p.m. of applied copper the residual was about 50 per cent while at 2 and 3 p.p.m. applied it was about 30 per cent.

Order of Addition of Chemicals. When copper sulfate was added first, with or without ammonia, and chlorine added last, a cloud of precipitated copper came out of the downstream end of the mixing pipe. When no anhydrous ammonia was used and chlorine was added first, followed by copper sulfate, the solution leaving the pipe was clear and precipitation took place slowly after the stream of water from the pipe had mixed with the main body of water. This was controlled entirely by the existing pH values. Any acid would have served this purpose as well as chlorine. There is no evidence to show that this method of feeding resulted in more soluble copper in settled water but it appears obvious that a better and faster mixture with the water was obtained. The control of plankton was better, but only experience can tell whether or not this was the sole factor.

The Three Chemicals. Copper and chlorine both were helpful in controlling plankton growth, the former being effective more generally. The diatom, *Achnanthes*, resisted more than 1 p.p.m. of copper sulfate and yet was unable to grow in the presence of as little as 0.25 p.p.m. of chlorine even when it was present as an amine. In contrast to this situation, an unidentified filamentous micro-

organism withstood applications of 4 p.p.m. of chlorine when the "break-point" was a little under 3 p.p.m. but was eliminated with the application of 2 p.p.m. of copper sulfate.

High bacterial counts in the settled water were due to multiplication and were in inverse ratio to the distance residual chlorine persisted through the settling basin. In one instance, using 3 p.p.m. of copper sulfate and 0.8 p.p.m. of chlorine, the bacteriologic counts of water leaving the basin averaged 1,000 and the plankton 2,700. During the next few days the copper was held at the same rate and the chlorine increased to 2.5 p.p.m. applied. The bacteriologic counts increased to 7,300 and the plankton fell to 1,250. In the first instance, the chlorine was fed at a rate resulting in the formation of chloramine with the natural ammonia in the water. This chloramine carried well through the basin and held bacterial counts low but was insufficient to interfere with the plankton. In the second instance, the chlorine was dissipated more rapidly, permitting bacterial aftergrowth. The high rate of application, however, killed more algae and the copper prevented rapid regrowth.

For the twenty-nine summers during which the settling basin had been in use with only local and intermittent use of copper sulfate, floating algae were skimmed frequently at the outlet. Since 1937 with the almost continuous use of copper sulfate and chlorine, with and without ammonia, practically no algae have been skimmed from the basin beyond the treatment point.

Odor Control. Using the ammonia natural to the water for forming chloramines is not without its objections. Water containing an active plankton population usually suffers an increase in odor intensity when chlorinated short of the point at which ammonia is destroyed. In such a situation there are two alternatives. Most of such troubles come in warm weather. In this season the slow sand filters are biologically active and can be relied upon to remove ammonia and destroy many tastes. They will often remove tastes produced or intensified by what may be termed partial chlorination. If this is not possible due to low temperature or poor conditions of the filters, initial chlorination may be required to the point at which odors are destroyed and after sufficient contact time to accomplish this result, ammonia may be added to react with the chlorine remaining. If the residual chlorine is not sufficient to carry through the basin more may be added with suitable concentrations of ammonia to form chloramines. Thus odors may be destroyed and

residuals maintained to control certain growths sensitive to chlorine but resistant to copper.

Plankton Control in the Rapid Filter Plant. In the rapid-sand plant the detention period in the settling basin is slightly under 2.5 hours during the summer load. The advantage of copper treatment was less marked there than in the slow basin. Copper applied locally near the outlet weirs must be handled with care because it may cause the filters to unload. Applied with or just before the coagulant, it did kill some cells but its effectiveness was much reduced because it was precipitated quickly and was removed with the silt. High chlorine doses were advantageous in odor control because the rapid filters do not remove odor as well as do slow sand filters. When in some cases slight improvement was found after filtration through rapid filters, it was believed that the chlorine may have precipitated the odor producing substances. If this is true, it would appear that chlorination should precede coagulation sufficiently to allow the chlorine reactions to reach completion. Along with algaecidal treatment, or following it, heavy coagulation is required to remove the cells whether dead or alive. Simply killing diatoms does not protect the filters since the dead cells probably clog the sand as much as those that are alive.

While the treatments discussed in this report have been helpful in meeting rather difficult water conditions and have improved filter production, they are not regarded as panaceas. Combinations of the variety of micro-organisms to be controlled do not remain constant. The demand for water, the chemical composition of the mineral and organic content of the raw water, and its response to treatment all must be taken into consideration in choosing the best combination and rate of application of chemicals and the most advantageous point at which to add them.

Conclusions.

1. Copper sulfate is more generally effective than chlorine as an algaecide.

2. The solubility of copper sulfate in hard water is not improved materially by chlorine or ammonia or a combination of them.

3. Because of the possible effect of pH value and in some cases because of cost also, ammonium sulfate appears to be more suitable for use with chlorine when copper sulfate is a part of the treatment.

4. Copper sulfate added to an alkaline water in dilute solution is

mixed more thoroughly before precipitation than when a strong solution is used. The limiting factor in dilution is the pH value, 6.0 being the upper limit.

5. If chlorine is a part of the treatment, it is advantageous to feed it with or before the copper solution in order to reduce the pH value and permit greater dilution before addition to the water to be treated.

Laboratory Determinations Concerned With Chlorine-Ammonia Treatment

Tests for Residual Chlorine. The standard ortho-tolidine test, because of the low pH value at which it functions, measures residual chlorine, chlorine combined with ammonia, and probably also chlorine combined with other chlorine adsorption compounds which are decomposed under the acid conditions. Thus it cannot be depended upon to indicate precisely the type of residuals existing in a given water. However, pending further research in methods for measurement of chlorine in combination with ammonia, it can be used effectively for the control of chlorine-ammonia treatment of water when supported by frequent bacteriologic tests. During the past two years attention has been focused upon the development of a test which will differentiate between chloramines and residual chlorine or chlorine adsorption compounds. Methods have been advanced by Griffin (2), Wolfe (9), and McNamee (10), but these appear to be nonspecific over a wide range of residual values (11). Further investigation of this problem is essential. Within limitations the test suggested by Griffin may be useful. This depends upon the rate of the oxidizing reaction of chlorine on nitrites to form nitrates and the much slower rate at which chloramines will react with nitrites. The technic of this test is given by Griffin under the next major heading. Its value is limited by the ability of small amounts of chlorine to exist in equilibrium with nitrites and further by the slow rate of reaction with nitrites of other forms of combined chlorine than chloramines, such as the hypochlorites.

The directions in *Standard Methods for the Examination of Water and Sewage* for the determination of residual chlorine focus attention on the fact that the rate of reaction of ortho-tolidine with chlorine is more rapid than with the chloramines. In both cases it is indicated that the yellow color should be fully developed before any readings are made and that to reach this full development in the presence of chlorine alone at least 5 min. should ordinarily be allowed, but not over 15 min. Where ammonia treatment is used the contact time is

not specified except that it is suggested that it will be somewhat longer than where chlorine alone is present. The work of Laux (15) and unpublished data by Griffin confirm this point of view of varying rates of color formation in the presence of chlorine and chloramines. These investigations, however, indicate that, where chlorine alone is present, full color development will usually take place within 5 min. and that 80 to 90 per cent of the color will develop within the first few seconds of contact. Where chloramines are present the initial color development will be relatively slow, requiring about 5 min. to produce from 80 to 90 per cent of the full color at temperatures of from 20 to 25°C. With decreasing temperature the time required for color production in the presence of chloramine will increase to approximately 20 to 30 min. as 0°C. is approached. *Standard Methods* suggests that this rate of reaction may be speeded by warming the sample to 20°C. before adding the ortho-tolidine. Griffin feels that where chlorine alone is present, temperature will have little effect on the speed of this reaction.

Laux (12) utilized this differential in speed of reaction between ortho-tolidine, chlorine, and chloramine in the development of a test, known as the "flash test" for the control of "break-point" chlorination. Since the "flash" residual in this test indicates the amount of "free" chlorine present, probably in the form of undissociated hypochlorous acid, chlorination to this point usually indicates that enough chlorine has been added to remove the ammonia-nitrogen present and that the break-point has been reached provided that the pH is held in the neighborhood of 7.0 to 8.0. In those plants where chlorination is controlled by this test, uniformly superior bacterial results are being obtained.

Further studies of the analytical problems concerned with chlorine-ammonia treatment have indicated the desirability of determinations of nitrogen in its various forms in water in order to provide close control of the process.

Nitrogen Determination—Ammonia Nitrogen. The preferred method for determination of ammonia nitrogen, according to *Standard Methods*, consists of distillation and Nesslerization. Where the ammonia content is high, direct Nesslerization may be resorted to, although no mention is made concerning what is to be considered a high ammonia content. Neither is any mention made of the precautions to be taken when such determinations are to be made in the presence of chlorine or chloramine residuals.

In the method for the determination of nitrite nitrogen attention is

drawn to the necessity of making nitrite tests immediately upon receipt of samples lest the nitrites be converted into nitrates or ammonia by bacterial action. In the tests for free ammonia no mention is made of the possible loss of ammonia nitrogen from the same cause. It has been observed that marked changes in ammonia content of water samples occur within a few hours—observations which are in accord with the original concepts relating to determinations of ammonia and the development of the use of Nessler's reagent.

TABLE 6

Nitrite Determinations at Peekskill, New York, Filtration Plant, Upon Addition of 0.25 p.p.m. Ammonia Nitrogen

SAMPLE NO.	CHLORINE APPLIED	CHLORINE RESIDUAL AFTER ONE-HOUR CONTACT	*NITRITES—NITROGEN	†NITRITES—NITROGEN
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*
1	0.00	0.00	0.0	0
2	0.75	0.43	0.0	0
3	1.50	0.98	0.0	0
4	2.25	1.02	0.0	0
5	3.00	0.63	0.0	0
6	3.75	0.23	0.001	0
7	4.50	1.03 F.P.‡	0.002	0
8	5.25	1.57	0.004	0
9	6.00	1.96	0.008	0
10	6.75	2.48	0.010	0
11	7.50	3.36	0.012	0
12	8.25	3.73	0.012	0

* Sulfanilic acid added first.
† Naphthylamine added first.
‡ Flash-point with ortho-tolidine.

In the course of the work carried on by the Committee it was noted that where it became necessary to determine the ammonia nitrogen content in the presence of chlorine residuals check results could not be obtained in those cases where sodium thiosulfate was used for the reduction of the chlorine. These difficulties were overcome when sulfurous acid was used. Experience with this reagent, however, indicated that in order to obtain satisfactory results there should be no excess of acid. This can be controlled by making the sulfurous acid equivalent in strength to the sodium thiosulfate used in titrating the chlorine residuals and then adding equivalent volumes of the acid to the sample under test.

Determination of ammonia nitrogen by direct Nesslerization seems to give consistently low results, particularly where the residual chlorine is not first neutralized.

Nitrogen Determination—Nitrite Nitrogen. The nitrite content of water is usually determined by the Griess test. "It depends in principle upon the red coloration ('azobenzol-naphthylamine sulfonic acid') produced whenever 'sulfonic acid' and 'naphthylamine hydrochloride' are added to an acidified solution of nitrite" (13). For years this test has been used with no change other than the substitution of acetic acid for the hydrochloric acid in the preparation of the naphthylamine. Apparently it has given good results for little criticism has been heard. Within the past year, however, there have been indications of interference particularly in those cases where nitrite determinations are made in the presence of chlorine residuals beyond the "break-point" (14). Where such residuals prevail colors similar to those produced in the presence of nitrites have appeared beyond the "break," a region where it is chemically impossible for nitrites to exist. In "hump" regions under the same conditions no nitrites have been detected and this in a region where it might be possible for them to be. An example of this phenomenon is presented in Table 6. These deviations from normal are being studied by the *Standard Methods* Committee of the American Public Health Association and American Water Works Association.

The new test for nitrites proposed by Martha B. Shinn (15), wherein sulfanilamide and *N*-(1-napthyl)-ethylenediamine dihydrochloride are substituted for sulfanilic acid and napthylamine is being investigated as to its reaction in the presence of chlorine.

Tentative Chlorine-Chloramine Differential Test—*A. E. Griffin*

A. *Reagents*

1. Sodium nitrite ($NaNO_2$) Stock solution
   Strength—15,000 p.p.m. or more
   Storage—Store in dark, cool place—refrigerator where possible
   Stability—Sodium nitrite is an unstable compound which begins to decompose immediately upon solution. For this reason the stock solution should be made up fresh at least once each week.
2. Sodium nitrite—Working solution
   Strength—10 p.p.m. when 10-ml. samples are to be tested

15 p.p.m. when 15-ml. samples are to be tested
25 p.p.m. when 25-ml. samples are to be tested, etc.
Example: 1 ml. of 15 p.p.m. nitrite added to
15 ml. of sample = 1 p.p.m. sodium nitrite

Stability—Very unstable; should be made fresh every day

3. Ortho-tolidine

Strength—*Standard Methods* type (10% HCl)
or
Standard Methods type (excess acid)

B. *Apparatus*

Wallace and Tiernan, Hellige type comparator or equivalent

C. *Procedure*

1. Test for total chlorine present in usual way, using ortho-tolidine indicator. Record results.

2. Collect a second sample and place half of it in each of two comparator cells.

3. Add to one cell an amount of sodium nitrite equivalent in p.p.m. to $1\frac{1}{2}$ times the indicated amount of chlorine present as determined in (1) and mix.

4. After an interval of not more than one minute, add ortho-tolidine to both cells, using 2 ml. of reagent (excess acid) per 100 ml. of sample. If Wallace and Tiernan comparator is used, add 0.5 ml. of standard ortho-tolidine to 15 ml. of sample.

5. Place both in the dark.

6. After interval of sufficient length to allow full development of yellow ortho-tolidine color, read color against the regulation chlorine standard.

D. *Interpretation*

1. Residual indicated on untreated sample will represent the total amount of chlorine present and should be equal to (1) under (C).

2. Residual present in nitrite-treated sample will give some indication of the amount of chloramine present.

3. Difference between the two should represent the amount of chlorine present.

NOTE: Where false residuals of any appreciable amount are present, this test does not apply without first checking the reactions between the nitrite added and the material causing the false residuals.

Summary

The numerous published reports attest to the importance and value of chlorine-ammonia treatment of water supplies and the very definite place that this treatment has attained in water technology. In 1938, replies to a questionnaire indicated that 16 per cent of the public water supplies treated with chlorine were also being conditioned with ammonia with generally satisfactory results. In only three states was it indicated that chlorine-ammonia treatment was not used in any public water supply.

The question of the formation of chloramines by the addition of chlorine and ammonia to water has not been entirely settled although recent work in connection with studies of super-chlorination treatment of water indicates that chloramines may be formed when chlorine is added to water containing ammonia nitrogen, provided that the ammonia nitrogen is in excess. These studies further suggest that in dilute concentrations mono-chloramines are formed at approximately pH 9.0 and di-chloramines at approximately pH 5.0 with mixtures of these two compounds existing in intermediate pH values. When chlorine is in excess of the ammonia, other reactions take place resulting in loss of ammonia.

Although originally it was felt that gaseous ammonia was necessary for the formation of chloramines, additional studies have indicated that other sources of ammonia, such as the various ammonium salts, can be used with complete satisfaction in those treatments. Apparently the natural ammonia present in water if in sufficient concentration will react in the same manner as the forms of added ammonia, or ammonia compounds.

Although first used to control taste and odor conditions resulting from chlorination when phenolic substances were present in water, chlorine-ammonia treatment has been found effective for the control of other types of odor conditions. It cannot, however, be considered a panacea for all such problems since instances have been found where it has failed to give satisfactory results, thus indicating that each problem must be studied by itself to determine the efficiency of the use of this treatment to control a particular odor or taste.

Chlorine-ammonia compounds have been found in general effective in the control of micro-organisms of the coliform group, although again conditions are occasionally met where chloramines even when present in effective concentrations fail to control growths of spore-forming micro-organisms which produce gas by the fermentation of lactose.

Because of the slow rate at which chloramines function as disinfectants, it is necessary that either a longer time be allowed to elapse after treatment before consumption of the water or that larger concentrations of chloramines be used than have been found necessary with chlorine alone. General experience has indicated that for effective treatment the chloramine residual should be maintained at least twice the amount found effective with chlorine alone and that not less than two hours' time of contact is necessary for effective disinfection with chloramines. Bactericidal efficiency is of course a function of the pH value of the water and the proper residual to be maintained at a given pH value must be determined in each case by experiment with close bacteriologic control.

One of the effective uses of chlorine-ammonia treatment has been the control of slime growths in distribution systems and particularly the control of bacteriologic conditions in dead ends which frequently lead to disagreeable tastes and odors. At Utica, N. Y., and Little Rock, Ark., the maintenance of effective chlorine residuals in pipe lines has been most effective in restricting development of growths of slime-forming bacteria and thus in maintaining the capacity of the pipes. One of the particularly interesting applications of chlorine-ammonia treatment has been in the control of growths of algae in reservoirs, coagulating basins, and other parts of water supplies. Harold of the London Metropolitan Water Board found that copper sulfate when used with chlorine and anhydrous ammonia satisfactorily controlled algae growths in the distributing reservoirs of that supply. Further experiments were undertaken by Calvert in Indianapolis who concluded that copper sulfate is a more effective algaecide than chlorine and that its solubility in hard waters is not materially improved by parallel chlorine-ammonia treatment. He found that the use of chloramines with copper sulfate was helpful and improved filter operation, but that it could not be considered a generally satisfactory remedy for algae control. The mineral and organic compounds of the raw water and its response were controlling factors in the efficiency of the so-called cupric chloramines and he did not find that the variety of micro-organisms controlled was constant.

There has been a demand for laboratory tests that will differentiate between residuals resulting from chlorine and chloramines. Various tests have been suggested for this purpose but none has been found sufficiently specific to warrant its routine use. Thus it becomes necessary to continue the use of the standard ortho-tolidine method for the

estimation of chlorine residuals although it must be understood that this technic will measure chlorine residuals as well as chloramine residuals and probably also some chlorine loosely compounded with organic material and of limited bactericidal value. Although the rate of color formation with ortho-tolidine is slower with chloramines than with chlorine alone, experience has indicated that color development obtained with a 5-minute reaction at 20°C. period provides a practical measure of effective concentrations of chloramines. Further study of this problem of differential tests is desirable for proper control of chlorine-ammonia treatment.

Although the chlorine-ammonia treatment of water has been found effective in most cases and has generally been accepted as a standard procedure, further investigation of the fundamental principles involved should be considered. Without doubt the effectiveness of the treatment in many instances is dependent upon local conditions such as composition of the raw water and the mechanical facilities available. Thus, it will still be necessary to experiment in each installation with consideration for all of the specific factors concerned in the given supply. It is quite probable that much further information will be developed by studying the treatment of water with excessive doses of chlorine for taste and odor control and thus that the future of chlorine-ammonia treatment is closely bound to the broader subject of the complete study of the effectiveness of chlorine treatment in general.

Recommendations

Based on its investigations, the Committee for the Study of Chlorine-Ammonia Treatment of Water makes the following recommendations:

1. That the proper application of the treatment be considered an effective means for disinfecting waters where chlorinous tastes and odors must be limited.

2. That the proper application of the treatment be considered an effective means of maintaining residual chlorine values in distribution systems and other parts of a water supply.

3. That the treatment be adopted in a given supply only after complete investigation of its efficacy under the existing local conditions.

4. That the treatment be carefully controlled, and that in general to insure adequate disinfection the residuals maintained be not less than twice those found effective with chlorine alone and that a minimum period of contact of two hours be provided.

5. That to obtain rapid disinfection when the production of taste and odor conditions is not a factor, chlorine be added in advance of the ammonia and that only sufficient ammonia be used to react with the chlorine to maintain adequate residual chlorine concentrations in the distribution system.

6. That the ortho-tolidine test be used to measure chloramine residuals, following the same technic established for the measurement of chlorine residuals.

7. That, from the data at present available, the control of algae in water by the use of copper sulfate in conjunction with chlorine and ammonia be not considered more effective than the use of copper sulfate alone.

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Appendix—Survey of Literature—*Harry A. Faber*

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The History of Taste and Odor Control

By William W. Hassler

THE purpose of this paper is to present the history of taste and odor control as it unfolded before the efforts of the men who devoted their interests to water research. Developments are viewed, wherever possible, from the standpoint of a person living during the particular period or epoch discussed, so that the difficulties encountered, as well as their solutions, will be more fully appreciated. Methods of treatment, which today seem elementary, may thus be seen as the result of the efforts and frequent mistakes of numerous workers. It is believed that the true significance of taste and odor control to water purification can best be realized by this approach.

The human race consumes more water than any other single article of diet. Considering this fact, it is surprising that little serious attention was devoted to the subject of water purification until little more than a hundred years ago, when, in 1829, a slow sand filter was installed in the Chelsea Water Works Co. of London and, in 1832, the first filters in this country were put into service at Richmond, Va. (*cited in ref.* 1).

Early purification efforts were directed principally toward producing clear colorless water, then believed to be safe. Water works operators also realized the desirability of supplying a palatable water, but progress in this direction lagged far behind developments in water disinfection. This was probably due, in large part, to the provincial mode of living before the advent of modern transportation. The population was not acquainted with the palatability of other water supplies and did not develop a "taste-and-odor consciousness."

The dream of a hundred years ago that someday consumers could turn on the tap and obtain a glass of taste-palatable water is today a reality. Early in 1940, Baylis (2) said: "In the very near future there will be little, or almost no unpalatable water served the public."

A contribution by William W. Hassler, Harrison Laboratories, University of Pennsylvania, Philadelphia.

Early Use of Charcoal Filters

The first method of taste and odor control to receive serious attention was the household filter, introduced toward the close of the Eighteenth Century (3). These filters contained layers of charcoal and sand, or charcoal alone, through which the water was filtered. The method was widely used during the Nineteenth Century and was the earliest general procedure for taste and odor control.

In 1852 charcoal filters were incorporated in a large scale project in the municipal water supply of Elizabeth, N. J.; and by 1883, 22 filtration plants in this country had installed filters of this type (4).

It should be emphasized that, although these early experiments with charcoal filters aided the removal of organic and other suspended matter, they did little to remove dissolved taste and odor substances present in water. The filters had a low adsorptive capacity and clogged easily, so, with the increasing adoption of rapid sand filters[1] toward the close of the century (6), they went out of style, to reappear later in a different form.

Introduction of Aeration

Nature has long purified water by the simple process of exposing it to the air. It is not surprising, therefore, that early attempts to remove tastes and odors merely elaborated on nature's method. The first attempt of this kind was made by the Hackensack Water Co. at Hoboken, N. J., in the fall of 1884 (*cited in* 1), where, in accordance with the plans designed by A. R. Leeds, compressed air was introduced into a reservoir. This system, known as aeration, has been employed longer than any other method for taste and odor removal. Between 1884 and 1905 it was the only method specifically designed for taste and odor control (5).

No completely satisfactory theory of aeration has yet been formulated. The generally accepted view is that exposure of a large surface of water to the air enables dissolved gases and volatile oils to escape

[1] The relationship of filtration to taste and odor control has been well summarized by Hansen (5), who states: "Filtration is not primarily a means of removing tastes and odors, although the processes of filtration in common use greatly reduce tastes and odors resulting from the presence of organisms. Therefore, it should not be omitted from any list of means for controlling tastes and odors. Filtration, however, is primarily intended for the removal of turbidity and bacteria."

into the atmosphere[2] (5). Others hold the view that aeration provides water with oxygen which oxidizes the substances producing tastes and odors (5). The fact that aeration removes volatile oils and gases without affecting many other oxidizable materials, e.g., phenols, seems to substantiate the former view. On the other hand, most surface waters will oxidize many wastes if the water is exposed to the air for sufficient time. Both theories possess merit.

Aerators based on both these principles have been designed and include many modifications of each type. The spray and cascade aerators utilize the principle of breaking water down into small droplets, thus exposing a larger surface to the air. Spray aerators force water through a nozzle, whereas the cascade type allows it to trickle over a series of steps. The other principal type of aerator includes numerous diffusion devices which bubble air through the water to enrich its oxygen supply (9, 10).

Aerators came into existence at a time when the principal sources of taste and odor were algae and dissolved gases from decaying vegetation. It was for the purpose of combating these that aeration proved of great value. Many investigators have found also that aeration is effective for the partial removal of tastes and odors due to certain algae[3] (11); and in addition it has proved efficacious in removing dissolved gases, such as hydrogen sulfide and carbon dioxide[4], which impart tastes and odors to water (10, 13, 15). Large amounts of decaying vegetation and organic matter deplete the dissolved oxygen of waters, producing a "flat" taste. In such cases aeration restores the oxygen supply, improving the taste (13).

Aeration proved unable to cope with the more difficult taste and odor problems, caused by industrial pollution and further aggravated by chlorination. This has reduced it to the status of a useful adjunct to improved methods of taste and odor control, for although aeration

[2] From a theoretical viewpoint this is explained on the basis that there is a gas-liquid film at the surface of the water. Absorption studies have proved that falling drops produce the thinnest films, thus reducing the distance dissolved gases must travel to escape from the liquid phase (7, 8).

[3] Oils secreted by *Synura* are peculiarly resistant to removal by aeration methods. Willcomb (12) reports only 50 per cent reduction when aeration is employed for *Synura*, and states: "Albany's experience indicates that carbon treatment alone is the more economical remedial measure." Hale (13) states: "It [*Synura*] readily disappears in an open reservoir following treatment with copper sulfate, i.e., after a few days."

[4] When present in minute amounts, carbon dioxide imparts taste to water (14).

has been of value in the removal of oils, it is inadequate in the elimination of many tastes and odors present in industrial wastes (5, 13, 16).

In spite of improved methods of taste and odor control, aeration still occupies an important position in that field. In 1935 more than 300 plants were using aeration (8), and more than half of them employed it for taste and odor control (7). Aside from its ability to alleviate certain tastes and odors, it is also one of the cheapest methods of control yet devised.[5]

Early Studies of Sterilization

Toward the close of the Nineteenth Century, water research was principally concerned with the problem of disinfection. The treatments evolved, although originally designed for sterilization purposes, were later found to aid the correction of tastes and odors. The early history of disinfection methods is related here to provide a background for their later development in the field of taste and odor control.

In 1890 the death rate from typhoid fever in the United States was between 80 and 100 per 100,000 population (17). In attempting to reduce the water-borne cases of the disease, chemical methods of treatment were developed. As early as 1883 Reidmeister (18) had proposed the use of an oxidizing treatment consisting of potassium permanganate followed by hydrogen peroxide to purify water, but the suggestion was not applied until 1900.

Seven years after Reidmeister's suggestion the first chemical treatment of water was begun, employing ozone as the sterilizing agent. The bactericidal properties of ozone had been observed by Fox in 1873 (19), and later confirmed by Ohlmueller (20), who employed it for water purification in 1893. Although the oxidizing power of ozone was noted at this time, however, its applicability to taste and odor control was not considered until twenty years later.

Not until the introduction of chlorination in 1896 was the foundation work, which later led to the widespread adoption of chemical water purification, laid. In that year W. M. Jewell, borrowing a process earlier used in sewage treatment generated and applied chlorine gas to a test filter at Louisville, Ky., under the direction of G. W. Fuller (21). A year later Jewell repeated the experiment at Adrian, Mich., and in that same year (1897) bleaching powder was used by Woodhead to combat a typhoid epidemic at Maidstone, England (*cited in* 1).

[5] In 1932 water could be aerated at a cost of 24 cents per mil.gal. (9).

Taste and Odor Control in the Twentieth Century

This brief sketch of Nineteenth Century taste and odor control thus draws to a close. Taste and odor conditions at this time as characterized by Wellington Donaldson (6) in relating his early experiences in the water field were:

"In the period around 1903 there was never any serious complaint about palatability of the water supply. Industrial wastes were not a factor and algae propagation in the open distributing reservoirs did not occur to any troublesome extent. This was fortunate because the means then available for controlling tastes and odors were limited practically to the one expedient of aeration."

Two factors were largely responsible for the increasing interest in taste and odor control during the Twentieth Century. The first of these was the widespread adoption of chlorination, which solved the problem of sterilization but introduced new sources of tastes and odors. Chlorination of water containing algae oils and other organic matter produced many objectionable tastes and odors, while chlorine itself imparted a characteristic taste to water. The second reason was the rapid development of chemical industries during the World War, which resulted in a marked increase in water pollution. Chlorination of these waters produced disagreeable medicinal tastes.

Water experts realized that solution to the problem was imperative. Not only was unpalatable water the cause of great dissatisfaction with water authorities, but many consumers, regarding the water as unsafe, resorted to private sources such as wells and springs, which, though palatable, were often bacteriologically unsafe. Several approaches to the problem were explored in numerous experiments. The results of investigations frequently laid dormant for many years before their value was generally accepted. From 1900 to 1925 the water consumer had little, if any, evidence that this research work had accomplished any results in improving the taste and odor of his water. In fact, the reverse probably seemed true in most cases. Nevertheless, these scattered investigations formed the framework for the subsequent rapid development of present day taste and odor control methods.

Early Investigations on Chemical Treatment

Fuller (21) used permanganate as a coagulant as early as 1898. Another early investigation was the use of potassium permanganate for iron removal at Providence, R. I., in 1900 (22). The literature of

this period also describes two instances (23) in which permanganate was used to destroy organic matter in water. This new treatment, however, did not evince widespread interest, nor was its applicability to taste and odor control then recognized.

In 1904, in another field, Rideal (24) conducted a series of experiments in which he discovered that the germicidal action of chlorine was increased by the addition of ammonia. Eleven years were to elapse before this discovery was applied in what came to be known as the chloramine treatment.

Development of Copper Sulfate Treatment

A second important development during the year 1904 was the publication of the copper sulfate treatment for algae control by Kellerman and Moore of the U. S. Department of Agriculture (25). This work followed the suggestion, made twelve years earlier by a German chemist, Kröhnke (26), that copper salts be used to disinfect polluted water. This recommendation had been supported further by the studies of Naegli, Israel and Klingmann (*cited in* 27), which demonstrated the toxicity of copper foil on certain bacteria and algae. Then, in 1901, Moore (28) had reported the successful application of copper sulfate for algae control.

During growth, the algae secrete fishy- and grassy-tasting oils. Chlorination of waters containing dead algae produces a medicinal taste (29). Copper sulfate, however, proved effective for inhibiting and destroying algae growth, thus preventing their propagation (5, 30). This treatment results in a temporary increase in tastes and odors due to the decomposition of dead algae, followed by an improvement in palatability. It should be noted that copper sulfate is a preventive treatment and does not remove tastes and odors present in the water. It functions by killing the algae which produce the tastes and odors[6].

Copper sulfate has become a universal treatment for algae-infested reservoirs. It is applied by dragging bags of the crystals over the surface of the water (33). The dosage required depends upon the types of algae present in the supply, ranging from 0.1 to 10.0 p.p.m., 1.0 to 4.0 p.p.m. being found effective for most types of algae (31, 32, 34).

[6] Formerly the view that copper sulfate dosages in excess of 0.2 p.p.m. caused a degeneration of the liver was common (*cited in* 31). Recent investigations by Hale (*cited in* 32), however, indicate that: "it seems definitely established in the negative that copper has a deleterious effect upon the health."

Since its introduction in 1904 there have been few major improvements in copper sulfate treatment. The combination copper sulfate chlorine-ammonia treatment known as cuprichloramine has been reported to be an effective algicide (33, 35). Another improvement in copper sulfate treatment was outlined in 1935 by R. F. Goudey (36). Briefly, the method consists of spraying crystals of various sizes over the surface of the water, thus providing more even distribution.

History of Chloramine

Scientists frequently develop and employ new methods of treatment before they fully understand them. This was true in the case of chloramine treatment as revealed in an unpublished bibliography compiled by L. V. Carpenter[7] which traces the history of chloramine back to the discovery of NCl_3 in 1811. Rideal had experimented with a combination chlorine-ammonia treatment in 1904, but it was three years later before its chemical nature was solved through an accidental discovery by Raschig[8] (37). Although Raschig's experiments were not conducted in conjunction with any phase of water purification, they constituted a theoretical basis for the later application of chloramine to this field.

Taste and Odor Problems Created by Chlorination

From Raschig's laboratory the scene shifts to Middelkerke, Belgium, where regular chlorination was first employed in 1902. Three years later Sir Alexander Houston in collaboration with Dr. McGowan systematically applied bleaching powder to the water supply of Lincoln, England. In this country the first use of permanent chlorination was at the Boonton reservoir of the Jersey City

[7] W.P.A. Project 465-97-3-35 for New York City. Manuscript furnished to the author through the courtesy of the A. W. W. A.

[8] Fritz Raschig while working with aniline and hypochlorite noticed that no color developed when these two compounds were reacted in the presence of ammonia. Further, he observed that nitrogen gas was evolved quickly from the reaction between concentrated solutions of ammonium hydroxide and sodium hypochlorite, but that this evolution was slow when the solutions were dilute. These facts led Raschig to formulate the existence of a compound intermediate between nitrogen and ammonia which he termed "chloramine," NH_2Cl. Raschig obtained a quantity of the compound by reacting two parts (by weight) of chlorine to one of ammonia producing the faint yellow oil ($NaOCl + NH_3 = NH_2Cl + NaOH$).

Water Co. in 1908. Chlorination was begun here as a result of the claim that the Jersey City Water Co. had failed to fulflll its obligation to supply "pure and wholesome water" (1).

Until 1913 bleaching powder was used almost exclusively as the chlorinating agent. However, bleach was difficult to handle, and it was replaced by liquid chlorine following independent work by Major Darnell of the U. S. Army, and Huy and Ornstein of Niagara Falls (*cited in* 1). Liquid chlorine everywhere proved effective and easy to apply, thus making possible its universal adoption for disinfection.

Chlorination proved to be a popular treatment, its use expanding rapidly. Water operators saw in it the answer to their sterilization problems. On the other hand, many observed disagreeable chlorinous tastes and odors following chlorination (38). Investigations have shown that chlorine in excess of 0.15 to 0.45 p.p.m. imparts a characteristic taste to water (39). Since early dosages ranged from 0.2 to 8.0 p.p.m. (1), sterilization by chlorine without the subsequent development of tastes and odors was virtually impossible[9].

New problems thus accompanied the introduction of chlorination. To quiet taste and odor complaints one plant reduced the chlorine dosage to such a point that an increase of typhoid fever resulted[10] (40). By one writer (42) it was stated that hypochlorite treatment would remain unsatisfactory until a method could be developed for eliminating the tastes it produced.

The fact that the cause might also be employed as a cure was realized at this time by Sir Alexander Houston who early developed control methods for tastes and odors resulting from chlorination. Chlorination had been practiced at Lincoln, England, for three years when in 1908, Houston observed that chlorine destroyed algae growths (*cited in* 43). This discovery collected dust until 1921, when Hale (*cited in* 6 *and* 44), followed by others (43, 45), further investigated the algicidal properties of chlorine, and popularizedits use for this purpose[11]. Its chief limitation as an algicide is the fact that certain algae develop a resistance to chlorine, but this difficulty is overcome by the addition of copper sulfate or by cleansing the basins (47).

For the control of obnoxious tastes and odors resulting from chlorination, Houston (48), in 1912, successfully treated one of the

[9] Efficient methods of de-chlorination had not yet been developed.

[10] The residual method of chlorine dosage control was instituted in 1918, at Luke, Md., by Wolman, Enslow and Patrick (41).

[11] Many investigators report successful use of chlorine as an algicide (43, 46).

Metropolitan Asylum Board's wells with an overdose followed by removal of the excess chlorine. Fourteen years later this principle was embodied in an improved method employed for the first time on a large scale to control tastes and odors by the process known as super-chlorination.

It is interesting to speculate the course taste and odor control might have followed had the importance of Houston's work been realized at the time. Perhaps it is well that his results attracted little attention, for experimentation, which eventually led to the efficient methods of modern taste and odor control, was spurred by the unsolved problem. Difficulties in the use of chlorine were probably largely responsible for the resurrection and improvement of previous treatments.

Use of Ozone, Potassium Permanganate and Carbon

Two new lines of approach to the problem were open: (1) the use of a sterilizing agent which did not accentuate tastes and odors already present in the water; and (2) correction of the chloro- tastes and odors by the use of a de-chlorinating agent. Ozone and potassium permanganate treatments were based on the first principle, while carbon treatment was of the latter type.

From theoretical considerations ozone appeared to be the ideal solution. It is equal to chlorine for sterilization purposes (49), and its oxidizing power improves the palatability without imparting a characteristic taste[12] (50). The practical application of ozone at Lindsay, Ont., in 1909, however, proved disappointing (49). Failure was attributed to mechanical difficulties, chief of which was the impossibility of obtaining uniform distribution of the gas throughout the water. Although a few plants have recently employed ozonation successfully, it has never become a widespread treatment in this country[13].

The year 1913 witnessed the emergence of potassium permanganate

[12] A rather interesting side light is the fact that ozone (derived from the Greek, ὄζω, meaning, "I smell") should be used to remove tastes and odors when the gas itself can be detected easily by the nose when present in concentrations as low as 1.0 p.p.m. of air by volume (51). The explanation of this anomaly lies in the fact that ozone rapidly decomposes into oxygen, which is odorless (52).

[13] In 1934 only three plants in this country were using ozone. In France, however, ozonation has been received favorably, 50 installations having been in operation in 1930 (49).

as a foe of tastes and odors. During that time Houston (53) employed it for the removal of a castor oil taste due to Tabellaria at the Middlesex Works, and for the next decade he carried on further investigations on the use of this reagent.

For the purpose of removing excess chlorine from water, filter units containing charcoal were manufactured by the Candy Filter Co. of England as early as 1910 (54). Use of this "De Chlor" process, as it was called, proved unsatisfactory due to the low adsorptive capacity of the carbon (8). Shortly after the introduction of the "De Chlor" system in England, the first activated carbon production in this country was begun by the Industrial Chemical Sales Co. in 1913 (8). Although industry early recognized the high adsorptive capacity of activated carbon, little, if any, consideration was given to its possible application for water treatment[14].

Development of Chloramine Sterilization

Progress toward a solution of chlorination problems was still at a standstill when in 1915–16 water research men made one of science's many accidental discoveries. Race (58), while searching for a method of reducing the cost of chlorination at Ottawa, Ont., discovered that ammonium hypochlorite had nearly three times the germicidal action of bleaching powder[15]. Laboratory success led to the use of ammonium hypochlorite at the principal plant in 1917. Not only was more economical sterilization accomplished by this new treatment, but freedom from tastes and odors was also noted—attributed, by Race to the decreased chlorine dosage. Although Race was primarily concerned with cheaper sterilization, his work also paved the way for the control of tastes and odors following chlorination.

Chloramine was next employed for sterilization and for prevention of aftergrowths at Denver, Colo., in 1917 (59), and at New York City, in 1918, by Hale (60), but the full value of chloramine for tastes and odors was not yet fully realized. Intensification of tastes and odors

[14] Successful employment of clays for control of tastes and odors during this period was reported in several instances (55), but, with few exceptions (56), their subsequent use has been limited. This is probably due to their low adsorptive capacity, reported by Baylis (57) to be less than 2 per cent of that of activated carbon.

[15] Race ascribed this to the decomposition of ammonium hypochlorite into chloramine and hypochlorous acid according to the equation: $NH_4ClO \rightleftarrows NH_2Cl + HClO$.

caused by the increasing volume of trade wastes, however, soon focused attention on this long neglected property.

In the post-war period, articles describing taste and odor outbreaks due to industrial wastes from ammonia stills, gas plants, and by-product coke ovens (61) began to appear in the literature. Investigations showed that phenol and allied substances present in these wastes imparted taste and odors to water[16] (62), which were further aggravated by chlorination[17] (64).

Taste and Odor Control by Chloramine and Chlorine

During the early Twenties experiments were conducted in England by Harold (66) and Adams (67) which revealed that chloramine could be used not only to correct unpalatability due to chlorine alone, but also to repress the uprising of chlorophenolic tastes which had begun to infest water supplies.

Meanwhile experiments along an entirely different line were conducted by Houston (48, 68), Brush (69), Adams (70) and Howard (71), confirming Houston's earlier observation that excess chlorine treatment removed or reduced various tastes and odors, including the newest types from the chlorination of phenols. These experiments constituted the foundation for Howard's monumental work on super-chlorination which was to follow.

Status of Water Palatability in the Early Twenties

In a paper presented before the American Society of Municipal Improvements at Atlanta, Ga., the following statement was made (*cited in* 2):

"Very few public supplies are satisfactory, in regard to taste, to all consumers. In many cities the amount expended for spring or bottled water is enormous. Part of this may be attributed to a mistaken idea that spring water is naturally better than any other water, but in most instances the reason is its palatableness.

"Changes in our mode of living and the vast amount expended for things that add comfort to our lives justify the assumption that we are now ready for more progress in improving the palatableness of

[16] Phenol imparts taste to water when present in quantities of 0.002 p.p.m.

[17] Baylis (*cited in* 65) found that 0.005 p.p.m. phenol in Lake Michigan water is sufficient to cause tastes when the water is chlorinated.

water. The health authorities have been satisfied as to the sanitary qualities; now we must satisfy the consumer as to its palatableness."

The first quarter of the Twentieth Century had passed without any general improvement in taste and odor control methods. In addition, tastes and odors of natural origin had been supplemented by those from industrial sources. A traveling public was becoming more and more taste-and-odor conscious. No longer would water operators be able to remark that consumers become accustomed to slight tastes and odors or else get tired of complaining (72). By 1928 consumers attached such importance to taste and odor control that in one instance a commission was established to provide a new water supply because of the unpalatability of the existing one (73).

The stage was thus set for enactment of the most colorful drama water purification had witnessed since the introduction of chlorination. The background had been prepared by far-seeing water research workers whose results were now to be employed by competent successors in the development and application of effective taste and odor control methods, notably, those of super-chlorination, chloramine and activated carbon.

Control by Super-Chlorination

The intake of the Toronto, Ont., water supply is located in Lake Ontario. Before 1926 taste troubles resulted every time the wind blew pollution from the harbor out into the intake. To correct this condition, Howard and Thompson (74) began a study to determine what substances caused the tastes and odors and, if possible, to evolve a solution. This early work has been described by Howard (75) as follows:

"We examined our sewage and were able to isolate both of these substances [phenol and cresol] and with this knowledge we treated water containing a trace of chlorine with phenol and cresol and produced a characteristic medicated taste which we designated as chlorophenol and chlorocresol.

"We next worked upon a method of treating water containing such combinations. We did a large amount of research work involving some three thousand experiments, treating them with varying quantities of chlorine. We found that as the chlorine dose was increased so the taste production increased with it.

"After some two years experimentation we were prepared to abandon the whole study, until one morning after going in and tasting a

sample which the previous night had contained a strong medicated taste, we found it free of taste. This gave us the clue we were looking for and we realized then that the time contact period was the solution to the problem."

The success of these laboratory experiments prompted the application of super-chlorination on a plant scale, and on September 2, 1926, treatment was begun at the Toronto plant. Until September 12 of that year over 70 m.g.d. were treated with 0.6 to 1.0 p.p.m. chlorine, followed by a contact period of 1 to 1½ hr., and finally de-chlorinated with sulfur dioxide. Taste-and-odor-free water was produced by this treatment, while untreated water acting as a control indicated the effectiveness of super-chlorination for taste and odor control. This method was again employed from September 28 to December 8, 1926, when lack of funds for necessary equipment halted further treatment until the summer of 1927. Renewal of taste troubles then prompted the financial grant necessary to provide permanent chlorination (76).

After "experiencing the wonderfully fine taste" of Toronto water, Hale (77) decided to try super-chlorination of a well supply which possessed a medicinal taste at Jamaica, N. Y. Treatment was begun in the summer of 1929 and proved successful. Several plants subsequently adopted this method.[18]

Various operators attach different significance to the meaning of super-chlorination (78). As it is generally practiced today, super-chlorination is usually defined as: "The use of such high doses as to require the subsequent use of a de-chlorinating agent" (79). Present day practice consists of the application of 1.5 to 10 p.p.m. chlorine, depending upon the nature of supply treated, followed by a contact period (usually 1 to 4 hr.) and then by de-chlorination with active carbon, sulfur dioxide or sodium sulfite (33, 35, 78).

In 1930, Howard (80) described a procedure which has recently attracted considerable attention under the name of "break-point chlorination" (81). This method determines the proper chlorine dosage by plotting the course of chlorine residual following the application of varying amounts of chlorine. The shape of the curve thus formed is influenced by various constituents in the water; consequently, the proper application of break-point chlorination is a matter for individual study for each water supply.

Super-chlorination has proved of value in taste and odor control.

[18] Faber (78) describes ten plants using super-chlorination in 1939.

Baylis (8) lists the following tastes and odors which are reduced or eliminated by its use: chloro-, fishy, algae, decaying vegetation, aldehol, and hydrogen sulfides.[19]

In spite of its reported usefulness, super-chlorination has not been employed widely because it has been ineffective for combating some types of tastes and odors (11, 83) and also because: "of all methods of treatment employed, it is the most difficult to control" (35).

Application of Chloramination to Taste and Odor Control

Chloramination was the next treatment to be resurrected for application to taste and odor control. Fourteen years after he had instituted chloramine treatment, Race (84) made the following interesting comment:

"When I first used this process in Ottawa in 1916, the object was to obtain the same germicidal effect with a smaller dose of chlorine, but now it appears that this advantage of chloramine . . . is but of minor interest as compared with the freedom from complaint that can be obtained with its use. In this connection, it is rather amusing to note that the objectionable taste and odors occasionally produced by chlorination were, at one time, attributed to the production of chloramine."

The use of chloramine for taste and odor control, as described by Race, was first successfully applied on a plant scale by McAmis (85) at Greenville, Tenn. The water at this plant contained an objectionable taste believed to be caused by phenol. McAmis had read of Harold's success with chloramine and decided to apply it to the Greenville supply. On August 20, 1926, ammonia was added to the raw water and liquid chlorine to the filtered water resulting in a distinct taste improvement. Spaulding (86) at Springfield, Ill., used

[19] Two explanations (78) have been offered for the removal of tastes and odors by super-chlorination. The first assumes that nascent or active oxygen liberated by chlorine from water destroys the compounds that cause the tastes and odors. This is represented by the following equations:

$$Cl_2 + H_2O = HClO + HCl.$$

$$HClO = HCl + O.$$

$$O + \text{pollution substance} = \text{non-objectionable compound.}$$

The other theory assumes that the chlorine itself forms non-objectionable substitution products with the taste and odor bearing substances. Watzl (82) has emphasized the difficulty in formulating a definite mechanism for the action of chlorine due to the limited knowledge as to the chemical nature of taste and odor producing compounds.

chloramine to prevent chloro- tastes. Later in the same year Ruth (87) at Lancaster, Pa., and Harrison (88) at Bay City, Mich., also began chloramine treatment.

Chloramine treatment for taste and odor control achieved nation-wide prominence after the intensive investigations of Lawrence (89) and Braidech (90) at Cleveland, Ohio, in 1929. As early as 1921, Ellms and Lawrence (91) reported disagreeable tastes following chlorination of phenols which polluted the Cleveland supply. An investigation reported unfavorably on the use of super-chlorination followed by de-chlorination with activated carbon, whereupon a study of the chloramine treatment was begun. Over a period of five months 9,000 tests were run, and upon them the following conclusions were based:

1. Pre-ammoniation prevents tastes and odors with phenol concentration as high as 1.0 p.p.m.
2. High chlorine residuals can be maintained without producing chlorinous tastes and odors.
3. Installation and maintenance costs of chloramine are nominal.

Following this report, ammoniators were installed at the Cleveland plant, and treatment begun on November 1, 1929. As predicted, chlorophenolic and chlorinous tastes and odors were prevented.

Following the trail-blazing work of these early investigators, many operators installed the chloramine process only to abandon it again, almost immediately, as unsuccessful. It was not then generally realized that the ammonia-chlorine treatment is preventive and not remedial, i.e., chloramine will inhibit the formation of chlorine taste and odor, but will not remove tastes and odors already present (92). Once these limitations were realized, chloramination was revived and gained increasing favor among water operators. On January 1, 1930, about five installations were in use in the United States; nine months later the figure had risen to 70; and on May 25, 1931, there were 190 installations (93). A survey of twelve states in 1933 revealed that 35 per cent of all supplies treated for taste and odor control were employing chloramine (94).

Modern chloramine treatment (33, 49, 79, 92, 95) consists of a thorough mixing of ammonia with the water prior to chlorination. When phenols are absent, or, in general, when the chlorine demand of the raw water is low, the best point of applying the chloramine is to raw water. When phenols are present, or when the chlorine demand is high, the ammonia and chlorine should be applied to the filter

effluent. The ratio of ammonia to chlorine is usually 1:3 by weight, although a higher one is frequently employed for treating waters of high organic content. Ammonium sulfate, aqua ammonia, and anhydrous ammonia serve as sources of ammonia. The reaction of ammonia and chlorine produces a mixture of mono- or di-chloramines[20] used to produce sterile and palatable water.

The advantages and limitations of chloramine treatment have been described by Spaulding (86), Ellms (96), Goehring (95) and Smith (92), and may be summarized as follows:

1. With sufficient contact time, the ammonia-chlorine treatment is a more efficient sterilizing agent than chlorine alone.

2. As a means of eliminating tastes and odors caused by the condition of the untreated supply water, the effectiveness of the process is quite limited.

3. The ammonia-chlorine treatment has proved itself valuable in minimizing chlorophenolic tastes and odors.[21] It will not remove phenols, but prevents the intensification of their taste upon chlorination of the water.

4. Higher residual chlorine content may be maintained with ammonia present so that aftergrowth may be prevented by maintaining residual chlorine in the reservoirs and the distribution system without the danger of producing chlorinous tastes and odors.[22]

5. There is a difference in opinion as to its value for algae control.

6. Ammonia is simply and cheaply applied with no undesirable after-effects that necessitate special vigilance.

7. Practically no injurious effects are reported, and, on the other hand, now that the limitations on its use are better understood, the process is firmly established as a practice in water purification.

[20] Strictly speaking, chloramine refers to a class of compounds consisting of mono-chloramine (NH_2Cl), di-chloramine ($NHCl_2$) and tri-chloramine (NCl_3). An excellent discussion of chloramine chemistry has been presented by Berliner (93).

[21] The ability of chloramine to prevent chlorophenolic tastes has been explained chemically on the following basis (8): When ammonia is absent, $Cl_2 + H_2O \rightarrow HClO + HCl$; then, $HClO + C_6H_5OH \rightarrow ClC_6H_4OH + H_2O$, but if ammonia is present, $Cl_2 + NH_3 \rightarrow NH_2Cl + HCl$. Thus the ammonia ties up the chlorine, reducing the hypochlorous acid concentration below the point where it will react with the phenol.

[22] The prevention of chlorinous tastes and odors is based on the same principle as the one used to explain the prevention of chlorophenolic tastes. The chloramine permits such low concentration of free chlorine that only slight, if any, chlorinous tastes and odors are produced (8).

Temporary Importance of Potassium Permanganate

Chloramine soon yielded its position of importance to activated carbon, but, between the two peaks, potassium permanganate enjoyed a brief period as the center of attraction. Earlier in the decade, Houston (48, 97) had reported several instances in England where permanganate had been used to control tastes and odors, but not until the work of Caird, in 1928, did it attract attention in this country. At Rochester, N. Y., Caird (98) successfully treated phenolic odors with 0.05 to 0.09 p.p.m. potassium permanganate. By 1930, ten plants in this country were employing this treatment (44).

The basic principle underlying permanganate treatment is its power to oxidize phenols and other organic matter which give rise to tastes and odors upon chlorination[23] (88, 99, 100). Permanganate is usually applied by solution feed in dosages now ranging from 0.1 to 0.2 p.p.m. (8, 33, 100). Despite its early promise in controlling phenolic tastes and odors, however, the growth of potassium permanganate treatment has been very limited. A twelve-state survey in 1933 (94) showed that, of the supplies treated for taste and odor, only 0.9 per cent employed potassium permanganate. There are several reasons for this stunted growth, most important of which are:

1. The use of potassium permanganate appears limited to prevention of phenolic tastes (101).

2. Potassium permanganate may impart an astringent taste or odor (8, 33, 49, 100).

3. Manganese troubles sometimes result from permanganate treatment (44, 102).

4. Permanganate imparts a characteristic pink color when an overdose is employed (33, 103).

The Rise of Activated Carbon

No method of taste and odor control ever received more widespread attention than that accorded activated carbon. Palatable water and activated carbon have become inseparable in the minds of a great number of operators and consumers. Howard (104), who has had long experience with taste and odor problems, has stated: "Activated

[23] Potassium permanganate has been found more effective when applied prior to chlorination, indicating that it oxidizes phenols more readily than chlorophenols (100).

carbon used alone or in conjunction with other processes is the most flexible, and possibly most effective reagent."

Attention was focused on activated carbon for water treatment following the 1927 epidemic of chlorophenolic tastes in the Chicago water supply, which damaged about a half million dollars worth of food products. Two Chicago meat packing companies found that powdered activated carbon corrected the taste in their water, but this type of material was not considered economical for treatment of municipal water supplies (105).

Baylis (105), however, believed that granular activated carbon filters might control tastes and odors. He has recounted his outlook of that time as follows: "It was with the hope of developing a treatment that would be less subject to failure to eliminate tastes in the case of mishap or the wrong application of chemicals that the writer started experiments on the use of activated carbon for removing or preventing tastes and odors." Experimentation with a granular carbon unit, beginning in June 1928 proved that it would be successful in removing both phenols and excess chlorines from waters.

While Baylis was conducting experiments in this country, Sierp (106), in Germany, was also working on the removal of chlorophenolic tastes with active carbon. These results led to the installation of a granular active carbon filter at the Hamm Water Works in 1929 (107). A year later the first granular activated carbon filter in this country was put into use in Bay City, Mich., under the direction of Harrison (108). Prior to the successful use of granular filters, Harrison (109) had tried super- and de-chlorination, chloramine, and potassium permanganate without success.

Although granular carbon filters proved successful in removing tastes and odors (108, 110), few plants have adopted their use because of the rather high initial cost of installation (110), coupled with the fact that powdered activated carbon was found to be more flexible and easier to apply.

The first use of powdered activated carbon in this country preceded, by one year, Harrison's use of granular carbon filters. The New Milford Plant of the Hackensack Water Co. had been troubled for two years by what Spalding (111) termed, "an exceedingly strong odor resembling automobile exhaust gases," caused by the presence of an alcohol denaturing product called "aldehol." Super-chlorination, followed by de-chlorination was only partially successful in removing this taste, whereupon Spalding experimented with powdered

activated carbon. Laboratory success with this treatment was followed by its application on a plant scale. Spalding summarized this work in these words: "The results of various bottle-experiments confirmed by an actual plant-scale test of twenty days' duration indicate that this method of applying pulverized active char furnishes an effective and readily adaptable method of deodorizing water wherever it is applicable."

The importance of Spalding's success with powdered activated carbon was soon realized by many operators. Trowbridge (112) successfully employed powdered activated carbon for the removal of phenol from water at South Pittsburgh in 1930. By the end of 1931, this new method had been tried in about 150 plants. The figure rose to about 400 during 1932, and in 1938, over 1,000 plants were employing it (113).

The phenomenal growth of active carbon for taste and odor control is largely attributed to three principle factors—effectiveness, ease of application and flexibility. The effectiveness of activated carbon for taste and odor control is due to its ability to adsorb[24] (8) taste-and-odor-bearing substances. The following statements indicate the respect accorded activated carbon for taste and odor control:

Norcom and Dodd (115) state: "Objectionable odors in water, due to minute quantities of industrial wastes, can be removed by means of activated carbon."

Hansen (116) states: "The positiveness with which this material removes taste and odor from water assures for it a permanent place among water purification devices."

Baylis (117) states: "We are finding that many, if not all, the taste-producing compounds which have given trouble in public water supplies can be removed by carbon at an expenditure which water works can afford to make."

The popularity of activated carbon is due in no small measure to the ease with which it can be applied. The fundamental operation consists simply in getting the carbon dispersed throughout the water. Accurate dry and solution feeds are on the market (33), but when these are not available, a carbon slurry can be mixed in a pail or a barrel and the suspension applied to the supply (118).

Since "all tastes and odors likely to be present in a water supply

[24] Braidech (114) has presented an excellent discussion of adsorption.

can be removed with activated carbon" (8), operators can employ this treatment without previous investigation into the source of their taste and odors. This is a distinct advantage over methods the use of which is limited to the removal of specific types of taste-and-odor-producing compounds. This accounts for the use of activated carbon for taste and odor control during emergencies such as drought and flood (119).

The user of activated carbon has few application problems (120). No chemical knowledge is required for its use. The material is non-toxic and is in no sense a health hazard. Although an average dosage of activated carbon is about 2.0 p.p.m. (33), there is no danger if an over-dose is used.

The ease of application coupled with the fact that it is effective for taste and odor removal, regardless of the application point (8), provides wide flexibility in the use of powdered activated carbon. Carbon is added prior to coagulation when a long contact time is desirable (33). On the other hand, it has been stated (8) that greater efficiency is usually obtained when the carbon is applied to the filters, due to the fact that the coagulation process frequently removes some of the tastes and odors. When it is desired to combine the advantages of both points of application, the so-called "split treatment" is employed (121). This consists of applying part of the carbon before and part after the coagulation process. Activated carbon has also been successfully applied in reservoirs (122).

The flexibility of active carbon has made possible its successful use in conjunction with other chemical treatments such as chlorine and chloramine (35). Its future as an "all-around" treatment has been forecast by Baylis (113) as follows: "Therefore, the prediction for the future is the material increase in the amount of powdered activated carbon used."

Evaluation of Tastes and Odors

Since the development of activated carbon, water operators have been principally concerned with the quantitative aspects of taste and odor control. Measurement of tastes and odors would enable operators to determine what corrective treatment is needed, where it can be most effectively applied, and how much is needed. Scientifically, it would be desirable to accomplish this by measuring the concentration of the taste and odor producing compounds according to the usual physical methods. So little is known as to the nature

of these compounds[25], however, that it has proved more practical to use a new yardstick—the nose.

In this connection, C. H. Spaulding (123) deserves great credit for development of the "threshold test." This test assigns a threshold number to the odor of the water to be tested. The threshold value is simply the number of times the odor-bearing water must be diluted with odor-free water before no odor is detectable. When intelligently employed, the threshold test supplies the operator with very helpful information regarding his taste and odor problems. The test, admittedly, gives only approximate results, but it constitutes a vast improvement over former methods. Subsequent work to improve the threshold test has been carried on by Fair and Wells (124), Baylis (125), Gullans (126), Laughlin (127), Braidech (128), and others (129).

Conclusion

This history of taste and odor control thus concludes with the search for a satisfactory test to measure tastes and odors. It is encouraging that water operators are no longer primarily concerned with the development of new taste and odor control methods, but rather, in determining the best manner of applying the effective treatments now available. Nevertheless, Science has no permanent frontiers; and, although palatable water for all is now possible, improvements in existing methods, as well as an extension of their application, are probably the next step in the search for improving this most vital commodity.

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[25] Baylis (8) states that "exclusive of the chlorinous taste, it is doubtful if the exact chemical compounds responsible for 1 per cent of the tastes and odors in water supplies are known."

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Census of U. S. Municipal Water Softening Plants

By H. M. Olson

IN THE Census of Municipal Water Softening Plants in the United States (Journal A. W. W. A., **29**: 1682 (1937)) and subsequent revised censuses mimeographed for private distribution by the author, only the name of the community having the installation was given together with the type of treatment—zeolite or chemical precipitation. To provide more detailed data, then, a questionnaire covering important information on the various phases of treatment, loads, etc., was sent to all communities known to have water softening equipment. Information was received direct from water department officials, state departments of health, consulting engineers, manufacturers' representatives and private sources. It is printed as received and according to the author's interpretation in each case.

In some cases it may be noted, by comparison with previous censuses, that names of communities previously shown to have water softening have been omitted from the accompanying tabulation. This is due to several factors—wrong information, change in treatment, and abandonment of softening (in a very few cases, principally due to cost.)

Figure 1 shows the growth of municipal softening in the United States from 1905 to the present.

In the accompanying tabulation, the following states are not shown, no municipal softening plants in these states having been recorded: Connecticut, Idaho, Maine, New Hampshire, Oregon, Rhode Island, Tennessee, Utah, Vermont and Wyoming.

The division of softening plants by areas is as follows:

New England States (Massachusetts)	1
Northeastern States (Delaware, Maryland, New Jersey, New York and Pennsylvania)	57

A compilation by H. M. Olson, The Ohio Salt Co., Wadsworth, Ohio. This census is taken as of July 1, 1941.

Central States (Illinois, Indiana, Michigan, Ohio and Wisconsin)	250
Southern States, East of the Mississippi (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Virginia and West Virginia)	70
Western States (California, Nevada, and Washington)	11
Balance of States West of Mississippi (Arizona, Arkansas, Colorado, Iowa, Kansas, Louisiana, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota and Texas)	186

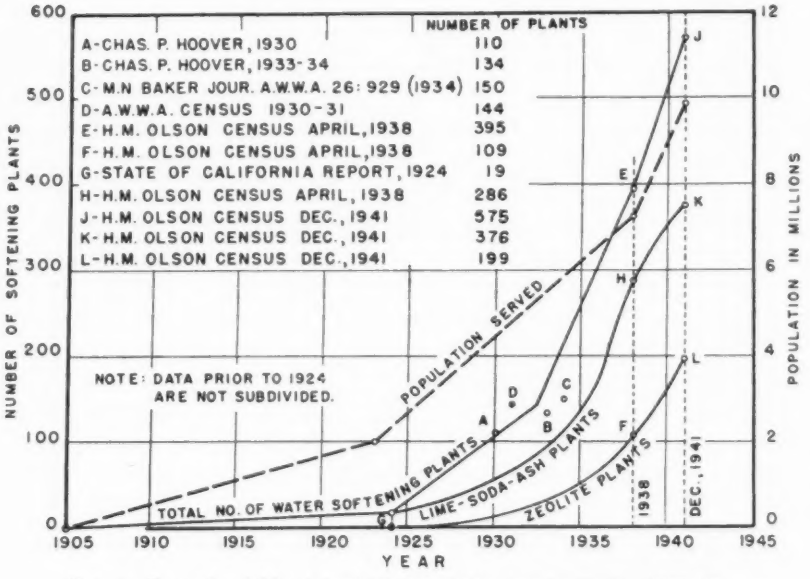

FIG. 1. Growth of Municipal Water Softening in U. S., 1905–41

According to the data in the ownership column, 65 softening plants are privately owned and 467 municipally owned. Two plants are owned by the United States Government—Boulder City, Nev., and Grand Coulee Dam, Wash.

Keeping in mind that some plants have more than one source of supply, it is interesting to note the following totals: well waters, 368; rivers and streams, 133; impounding reservoirs, 58; springs, 18; and mine waters in 3 cases.

In the tabulation are shown 199 zeolite plants and 377 chemical precipitation plants. San Mateo, Calif., has one plant of each type

and so is included in the totals for both types. La Grange, Ill., and La Verne, Calif., (Metropolitan Water Dist.) have lime-zeolite combination plants and are included in only the zeolite plant total. East Lansing, Mich., and Maywood, Ill., each have two zeolite plants; and Miami, Fla., has two chemical precipitation plants.

To the question: "Have maintenance (of distribution system) and other costs decreased," 139 replied "Yes" and 105 said "No." The paucity of replies indicates the lack of analyses, reports and interpretation in many plants. Despite the lack of statistical data, the author believes it is reasonable to expect that with cleaner mains and with corrosion control practiced at most of the plants, lower costs must result.

The data under "Type of Basin" may be somewhat confusing, for the information hoped for was not forthcoming in the answers to the questionnaires. Accelators and precipitators, and some similar equipment, are a recent development in the use of sludge blanket type of treatment to reduce reaction time and initial cost of equipment. This type of basin is indicated where replies were received but some actually in use may have been omitted. The fact to be gleaned from information in this column is that officials and engineers are ready to install new and proven types of treatment to improve the water quality.

Wide Range of Waters and Treatment

Raw water hardness indicates a great range chosen for treatment. A few raw water hardnesses are cited at below 100 p.p.m. and some ranging as high as around 1,000 p.p.m., with the great majority in the 200 p.p.m. to 500 p.p.m. range. In several instances the records show a tap water hardness of more than 300 p.p.m., but most range from well below 100 p.p.m. to less than 200 p.p.m. As will be noted in comparing the two hardness columns, some of the raw waters treated are softer than the tap water hardness after softening indicated for other plants.

Twenty years ago 100 p.p.m. in tap water hardness was considered very suitable but now 50 p.p.m. is considered the proper goal and in some cases even 40 p.p.m., but with proper pH control.

Tap water pH is a very important factor in the satisfactory and economical operation of a water works. It is important that proper reactions be set up or caused to be set up either to counteract or inhibit corrosive tendencies in the distribution systems, as well as

in the customers equipment, especially in hot-water storage tanks. The pH listed does not necessarily mean that $CaCO_3$ stability is obtained but in most cases the red water troubles are entirely or practically eliminated.

pH Control

In the operation of chemical precipitation plants the use of excess lime will in most cases determine the range of the pH value and, if it is too high, causing deposits in the distribution system, it can be reduced by means of recarbonation with CO_2, flue gas or natural gas or stabilized by means of Calgon (sodium hexametaphosphate) or similar phosphate compounds. In some cases CO_2 is used to reduce pH from high values at the end of softening to very low values, around 6.0, and then lime solution is again added to bring the pH to the proper $CaCO_3$ stability point.

In the compilation in the case of many of the chemical precipitation plants, CaO has been listed as a chemical used for pH control, whereas in other cases it is not shown; but in all cases it is the reaction of all of the chemicals used that determines the final pH and corrosive tendency of the water. Also in some cases, Calgon is used as a stabilizer along with other chemicals giving high pH resulting from treatment processes.

Where zeolite softening is used, the resulting pH values are usually far below $CaCO_3$ stability at the tap hardnesses used and some form of alkali is used to react with the calcium in the tap water to produce a proper $CaCO_3$ protection deposit. These can be: (1) soda ash, (2) soda ash and sodium silicate, (3) caustic soda, (4) caustic soda and sodium silicate, (5) sodium silicate, or (6) lime. Calgon or suitable phosphates are also used in some cases.

Some few plants can, where lime and zeolite are used, bypass part of the softened water to raise the pH to a proper point, as it is required in most such cases that the lime treated water be recarbonated by means of CO_2 to a figure well below 8.3 pH, usually 7.8 pH, so that it will not react on the zeolite mineral.

Population Served

The column on additional communities served was added so that all communities could be listed. Their population is included in the "Total Population Served" column. Thus, instead of having 574 communities with 578 softening plants, we have a total of ap-

proximately 800 or more communities which are being served in one way or another.

In listing the rated designed maximum capacity, the average production and the maximum production distributed per 24 hours, the object was to show the variations in demand for the different types of cities, on which might be based full capacity design rates for other cities. It may be noted that a great many plants do not show very much leeway between designed rate and maximum rate and that in some cases maximum rate is greater than the designed rate. In this latter case the plant has either outgrown its capacity or some great emergency existed.

In the total population column the endeavor has been to list all persons served, with the data obtained from the 1940 Census whenever possible—otherwise from the 1930 Census or from estimates. No population is shown in a few instances and undoubtedly some suburban population served has failed of inclusion. On the other hand, some allowance must be made for instances such as Utica, N. Y., where only 2 per cent of the total supply is softened spring water, and for varying industrial consumption. In some of the larger installations like La Verne, Calif. (Metropolitan Water District of Southern California), only a part of the communities are served softened water. The total of the population figures shown in the compilation is 9,912,075.

The division of plants by sizes of populations served is:

Under 1,000	147	20,000–50,000	31
1,000–5,000	240	50,000–1,000,000	22
5,000–10,000	78	Over 1,000,000	1
10,000–20,000	56	Total	575

Thus it may be seen that over two-thirds of the total plants are in communities of 5,000 or less population and that 96 per cent are in communities of less than 50,000 population.

Considerable information was received regarding the desirability of softened supplies, this information rather consistently citing savings in soaps, repairs, etc. as previously outlined by the author in "Benefits and Savings From Softened Water for Municipal Supply" (Jour. A. W. W. A., **31:** 607 (1939)).

KEY: *Ownership*—P for privately owned, M for municipally owned; *Raw Water Supply*—S for springs, W for wells, R for rivers and streams, I for impounding reservoirs; *Type of Softening Plant*—Z for zeolite, C for chemical precipitation; *Decrease in Costs*—Yes and No answers to "Have Maintenance (of distribution system) and other costs decreased?"; *Type of Settling Basin*—Cr for clarifier of radial flow type, Cs for clarifier of straight flow type, P for "Precipitator," A for "Accelator," Ps for plain settling basin. *Additional Communities*—symbols refer to footnotes listing additional communities served with softened water by the one community's plant. Populations of these communities are included in the last column, "Total Population Served." Populations given are from 1940 Census, except those in italic which are from 1930 Census or are estimated.

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) *p.p.m.*	TAP WATER HARDNESS ($CaCO_3$) *p.p.m.*	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY *1,000 g.p.d.*	AVERAGE PRODUCTION DISTRIBUTED, 1939 *1,000 g.p.d.*	MAXIMUM PRODUCTION DISTRIBUTED, 1939 *1,000 g.p.d.*	TOTAL POPULATION SERVED
Alabama:															
Berry	M	W	Z	1940			128	26	7.9	NaOH		57.6			639
Cherokee	M	S, W	Z				208	50	7.6	CaO		10	6		786
Courtland	M	W	Z	1937			198	70	7.4	CaO		40	7		454
Ft. Deposit	M	W	Z	1938			353	36	7.7	CaO		72	50		1,351
Arizona:															
Duncan	P	W	Z	1940			308	120				50			887
Grand Canyon	P	S	Z	1934	Yes	Ps	301	9	8.4			200	130	175	
Arkansas:															
Brinkley	P	W	C	1924		Ps	528	158	9.1			800			3,409
Clarksville	M	W	C	1931	No	Ps	580	120	9.8			750	222	389	3,118
Forrest City	M	W	C	1939	No		224	70	8.4	Calgon		1,500	525	1,050	5,699
Wynne	P	W	C	1923		Ps	293	94	8.6			1,310	150	200	3,633

Wynne	P	W	C	1923		Ps	293	94	8.6			1,510	150	200	3,...

California:															
Beverly Hills	M	W	C	1928 1931	Yes	P, Cs	266	146	8.4	CO_2		3,000 & 7,500	5,650	10,000	26,823
Contra Costa*	P	W	Z	1933			300	125				1,000	300		19,000
Coronado	P	W	C	1936			360	135				3,000	2,000		6,932
El Segundo	M	W	C	1938	No	Cs	296	168	8.1	CaO		2,000	607	964	3,738
Menlo Park	P	W	Z	1935			320	150			(1)	400			8,400
Metropolitan Water District of So. Calif., LaVerne	M	I	†	1940–41		Cr	360	92	9.3	Na_2CO_3‡	(2)	100,000			2,035,365
San Buenaventure	M	W, R	C	1939	No	Cs, P	446	161	8.2		(3)	4,500	3,000	3,500	13,264
San Mateo	P	W	C	1936	No	Cs, Ps	498	100	9.6	Calgon		1,000	500	500	19,403
San Mateo	P	W	Z	1935			375	100				400	200		
Santa Barbara	M	R, I	C	1937	Yes	Cr	513	239	8.3	CO_2		8,000	4,500	7,500	34,958
Colorado:															
Climax	P	§	C	1938		Cr, Ps	90–170	55	7.6	CO_2		224	125	200	*250*
Delaware:															
Selbyville	M		C												*661*

* Also another treatment plant—no softening.

† Lime-zeolite plant.

‡ Water crystallization is not included for the various commercial products cited by chemical symbols, i.e. where soda ash appeared in a questionnaire, Na_2CO_3 is shown. The term "caustic silicate" has been shown as caustic soda and sodium silicate.

§ Abandoned mine shaft and tunnel.

(1) Atherton, 1,908; other suburbs.

(2) Anaheim, 11,031; Beverly Hills, 28,823; Burbank, 34,337; Compton, 16,198; Fullerton, 10,442; Glendale, 82,582; Long Beach, 164,271; Los Angeles, 1,504,277; Pasadena, 81,864; San Marino, 8,175; Santa Ana, 31,921; Santa Monica, 53,500; Torrance, 9,950.

(3) One community outside of city.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
Florida:															
Arcadia	M	R	C	1939	No	Ps	35–200	70–150	8.4	$Ca(OH)_2$		1,000	284	510	4,055
Belle Glade	M	R	C	1939		A, Ps				CaO		480	125	336	3,806
Boca Raton	M	W	C	1927		Cr				CaO		500	275	440	723
Cocoa	M	I	C	1927		Ps	136	85	8.3	CaO	(4)	1,000	180	325	3,098
Daytona Beach	M	W	C	1937		Cr				CaO	(5)	4,000	1,700	2,300	22,584
Ft. Lauderdale	M	W	C	1930		Ps	310			CaO		6,060			17,996
Ft. Myers	M	W	C	1937	Yes	Cr, Ps	342	68	8.2	Na_2CO_3		2,000	600	1,200	10,604
Hialeah		W	C												3,958
Hollywood	M	W	Z	1935			256	76–95	7.8	Calgon		2,000	650	1,250	6,239
Live Oak	M	W	C	1937		Ps				CaO			170	190	3,427
Melbourne	M	W	C	1939	No	Cr, P		70–100	8.2–8.4	CO_2		220	120	150	2,622
Miami, Main Plant	M	W	C	1924		Cr	297	100	7.7	CO_2	(6)	40,000	19,000	30,000	200,184
Coconut Grove Plant	M	W	C	1925		Ps	288	90	7.8			1,500	595	1,050	3,377
Opa-Locka	M	W	C	1936	No	Ps	217	51				122	40	62	497
Ormond	M	W	C	1925		Ps				CaO	(7)		400	650	1,914
Punta Gorda	M	R	C	1937	Yes	Ps	55–200	50–75	8–8.4			500	150		1,889
St. Augustine	M	W	C	1937	No	Cr, Ps	377	83	8.6	Na_2CO_3		2,000	850	1,400	12,090
St. Petersburg	M	W	C	1935& 1937		Cr	190	100	7.5			10,000	3,617	5,750	60,812

Sarasota	M	W	Z	1937	No		1,055	85	7.7			1,000	700	900	11,141
Tampa	M	R	C	1926		Cs, Ps	120	114	7.9	$Ca(OH)_2$	(8)	16,000	7,470	10,240	108,391
Vero Beach	M	W	C	1920& 1925	No	Ps	272	64	8	CaO		1,000			3,050
Warrington		Z													*3,231*
Welaka			C												
Georgia:															
Dalton	M	R	C	1939	Yes	Ps	115	55	9.2	CO_2		1,500	1,200	1,900	10,448
Dublin	M	W	C	1936		Ps	170	37	9.0	Na_2CO_3		1,000			7,814
Summerville			Z												1,358
Thomasville	M	W	C	1931	No	Cs, Ps	190	68	8.5			1,500	670	1,000	12,683
Illinois:															
Alton	P	R	C	1938		Cr	281	98	8.9			7,600	4,000	5,000	31,255
Amboy	M	W	C	1939		Ps	376	85	8.6	CO_2		500	100	150	1,986
Anna	M	W	C	1937		A	300	75–85	8.9–9	CO_2, Calgon		860	276	346	4,092
Ashland	M	W	Z	1936	No							72	30	65	1,139
Ava	M	W	Z	1938			498	40	8.2	NaOH, Na_2SiO_3		12	8		821
Bethany	M	W	Z	1940			360	85	8.0	NaOH		110	15		819
Bloomington	M	I	C	1930	Yes	Cs	181	76	9.1	CO_2, Calgon		5,000	3,230	5,000	32,868
Bluffs	M	W	C	1936		Ps	615	100	9.2	CO_2		140	20		839
Canton	M	I	C	1940		A	250	85	9.6			2,100	400	600	11,577

(4) Rockledge, 725.
(5) Seabreeze, 1,338.
(6) Coral Gables, 8,294; El Portal, 365; Hialeah, 3,958; Miami Beach, 28,012; Miami Shores, 1,956; Miami Springs, 898.
(7) Holly Hill, 1,665.
(8) Port Tampa, 1,124; U. S. Army Air Base; Contiguous suburban area.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
Illinois—cont.															
Casey	M	W	C	1939		A	215	85	9.0	CO_2		432	180	250	2,543
Cerro Gordo	M	W	Z	1940			364	85	7.8	$NaOH$, Na_2SiO_3		120	40		1,016
Chandlerville	M	W	C	1936		A	418	50	9.3	CO_2		70	20		874
Cherry	M	W	Z	1941			302			$NaOH$, Na_2SiO_3		87			583
Clarendon Hills	M	W	Z	1936			530	68–70	7.8			100	60	75	1,281
Cobden	M	W	Z	1935			236	88	7.6			150	10		1,098
Colchester	M	W	Z	1935		Ps	427	68	7.8–8.0	Na_2CO_3		144	20	40	1,426
Decatur	M	R, I	C	1926		Cs, Ps	240	85–90	9.3	CO_2		18,000	7,250	8,750	59,305
De Land	M	W	Z	1937	Yes		440–680	90	6.8	Na_2CO_3, Na_2SiO_3		36	6	12	487
Des Plaines	M	W	C	1937	Yes	Ps	263	85	9.6	CaO, Calgon		1,500	610	908	9,518
Elgin	M	W	C	1938	Yes	Ps	273	85	9.1	CaO, CO_2		5,000	1,350	2,654	38,333
Eureka			C												1,714
Fairbury	M	W	C	1935	No	Ps	300	126	9.6	CaO		250	88	130	2,300
Fisher	M	W	Z	1936	Yes		475	70	8.0	Na_2SiO_3			22	30	754
Freeburg	M	R, I	C	1936		Cr	360	100	8.6			400	200	400	1,507
Gilman	M	W	Z	1939	Yes	Ps	590	76	8.0	Na_2SiO_3, $NaOH$		200	60	90	1,554
Greenfield	M	W	Z	1936	Yes		283	85	7.5			75	20	40	3,391
Hammond	M	W	Z	1937		Ps	380	100	8.4	Na_2CO_3		72			384

Greenfield	M	W	Z	1939		Ps	380	100	8.4	Na_2CO_3		72			384
Hammond	M	W	Z	1937		Ps	380	100	8.4	Na_2CO_3		72			384
Hartford	M	W	C	1936	Yes	Cs	280	90	9.1			288	42	86	1,842
Hinsdale	M	W	C	1924		Cs, Ps		68–85				3,000	700		7,336
Homewood	M	W	Z	1935			500	56	7.6			720	450		4,078
Jacksonville	M	I	C	1939	No	Ps	200	100	9.5			3,000	1,750	2,000	19,844
Jonesboro	M	W	Z	1937			341	85	8.2	NaOH, Na_2SiO_3		210	30		1,521
Kankakee	P	R	C	1930	No	Cs, Ps	345	68–70	9.8		(9)	6,000	2,857	2,960	22,241
Kansas	M	W	Z	1940		Ps	276	82	8.4	NaOH, Na_2SiO_3		90	13	25	875
Kincaid	M	I	C	1940		A	200	90	9.2			280			1,749
LaGrange*	M	W	*	1939		Cs	906	80	8.3	CaO, Calgon		3,000	730	1,143	10,479
Lebanon	M	W	C	1930		Cs, Ps						100	65		1,867
Le Roy	M	W	Z	1941		Ps	410								1,783
Loda			Z												507
Lovington	M	W	Z	1939	Yes	Ps	462	69	7.9	NaOH		108	30	36	1,215
Macon	M	W	Z	1937	No		300	75	7.3			100	21	49	875
Manito	M	W	Z	1936			267	93	7.4			100	15		776
Maroa	M	W	C	1938		A	336	77	9.2	CO_2		160	25		1,033
Martinsville	M	W	Z	1939	No		316	145					33		1,296
Mattoon	M	W, I	C	1937	Yes	Cs, Ps	300	90	9.4	Calgon		2,200	700	1,000	15,827
Maywood†	M	W, I	Z	1938	No		193	85	8–8.2	Na_2CO_3, Calgon		4,000	1,600	3,000	26,648
Monee	M	W	Z	1939			643	95	7.4			280	15		427
Monticello	M	W	Z	1936	Yes		243	77	7.5			500	200		
Morton	M	W	Z	1939	Yes	Ps	350	80	7.9	NaOH		576	150	225	2,523
Neoga	M	W	Z	1939			329	80	7.4			90	60		1,062
Newman	M	W	C	1936		A	304	65	9.0	CO_2		140	40		1,103
Nokomis	M	W	C	1935	No	Ps	550	100	9.6	Calgon		500	75	125	2,562
Oakland	M	I	C	1938		Ps	160	100	8.8			100	10	30	1,131
Oak Lawn	M	W	Z	1940		Ps	548	49–56	7.6			290			3,483

* Lime-zeolite plant.

† Two plants.

(9) East Bradley; West Kankakee.

Census of U. S. Municipal Water Softening Plants

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Illinois:—concl.															
Okawville	M	W	C	1937	No		284	147	8.5	Na_2CO_3, CaO		72			708
Peru	M	W	C	1933	Yes	Cr, Ps	393	68	8.4			1,500	700	1,250	8,983
Petersburg	M	W	Z	1940			225	93	7.6	NaOH	(10)	360			2,586
Princeton	M	W	C	1930	Yes	Ps	215	68	8.8	Calgon		1,060	400	600	5,224
Quincy	M	R	C	1932	No	Cr, Ps	180	114	9.0			6,000	2,919	4,611	40,469
Ridgway	M	W	Z	1939	Yes	Ps	360	78	7.8			144	10	29	1,167
Sandwich	M	W	Z	1939	No	Ps	750	350	8.2			300	160	200	2,608
South Elgin	M	W	Z	1938			288	125	7.8			125	15		961
Sparland	M	W	Z	1937			672	106	7.6			70	2		509
Springfield	M	I	C	1926	Yes	P	170	80	9.8	Calgon	(11)	12,000	8,000	13,000	75,503
Stonington	M	W	Z	1935			300	46	7.4			120	24		1,103
Stronghurst	M	W	Z	1939			305	90	8.4	NaOH, Na_2SiO_3			80	5	691
Sullivan	M	W	Z	1936	Yes	Ps	376	85	8.8	Calgon	(12)	360	150	210	3,101
Valmeyer	M	W	Z	1941			453			NaOH, Na_2SiO_3		220			591
Villa Grove	M	W	C	1936	Yes	Ps	215	81	9.3	CaO, Fe, $Al_2(SO_4)_3$		440	120	200	2,072
Western Springs	M	W	C	1931	Yes	Cs	920	102	9.2	CaO, CO_2		1,500	330	400	4,856
Westmont			Z	1941											3,044
Williamsfield	M	W	Z	1940			333	100	8.0	NaOH, Na_2SiO_3		25	7		470
Winchester	M	W	C	1935		Ps	270	114	9.2	CO_2		210	40		1,651

Woodstock	M	W	C	1934	No	P	380	85	9.2			3,000	1,000	1,500	6,123
Yates City	M	W	Z	1941			312	85				115			576
Zion	M	W	Z	1928			318	100	7.6	CaO		100	75		6,555
Indiana:															
Albany	M	W	Z	1939	Yes	Ps	479	68	7.8	Na_2SiO_3, NaOH		200	62	90	1,623
Angola	M	W	Z	1939			400	164	7.5			1,000			3,141
Argos	M	W	Z				325		7.5–7.9			360			1,190
Bicknell	M	W	Z	1937	Yes	Ps	478–547	85	8.0	Na_2SiO_3, NaOH		432	188	384	5,110
Crown Point	M	W	Z	1936	No	Ps	533	130	7.5	CaO		1,000	450	650	4,643
Dunkirk	M	W	Z	1939		Ps	450	95	8.0	Na_2SiO_3, NaOH		300	70	125	2,942
Elnora			C												799
Fort Wayne	M	W, R, I	C	1934	No	Cs, Ps	278	92	9.2	CaO, Na_2CO_3		24,000	10,141	16,020	118,410
Lebanon	M	W	C	1935	No	Cr, Ps	394	188	8.8	CaO	(13)	1,000	331	670	6,529
Marion	M	W	C	1926		Cr, Ps	581	410	7.7	CaO-Catalyzer		3,000	2,360	5,400	26,767
Morroco	M	W	Z	1939	Yes		500	32	7.6		(14)	360	70		1,151
Portland	M	W	C			A	600			CaO		1,000			6,362
Princeton	P	R	C	1937	No	Ps	300	200	8.2	CaO, Calgon, CO_2		2,500	800	1,150	7,786
Rochester	M	W	Z	1939		Ps	274	51	7.7	Na_2SiO_3, NaOH		1,000	275	483	3,835
Waynedale	P	W	Z	1940			388	102	7.7	Na_2SiO_3, NaOH		216			*950*
West Terre Haute	M	W	Z	1940			400	85	8.0	Na_2SiO_3, NaOH		225	50	93	3,729

(10) New Salem State Park.
(11) Auburn, 1,952; Chatham, 867; Divernon, 1,033; Girard, 1,741; Pawnee, 1,006; Riverton, 1,524; Rochester, 464; Virden, 3,041.
(12) Masonic Home.
(13) Ullin, 827.
(14) New York Central Rail Road.

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Iowa:															
Adel	M	R	C	1936		Ps	300	100	7.7–8.3				85	125	*1,669*
Ames	M	W	C	1932	Yes	Cr	375	77	8.6	CaO, CO_2	(15)	2,000	1,100	1,950	12,555
Avoca		W, I	C	1938		A	752						52		*526*
Belmond	M	W, I	C	1934	Yes	Ps	359					360			*1,733*
Cedar Rapids	M	R	C	1930	No	Cs	198	96	8.6	CO_2		12,000	4,915	8,495	62,120
Churdan	M	W	C	1923	Yes	Ps	666	334				58	20	35	*616*
Eagle Grove	M	W, I	C	1936	No	Ps	359	103	8.6			720	160	281	4,071
Farnhamville	M	W	C	1930		A, Ps	340	342	7.8			20	16		365
Glidden	M	W	Z	1936			417	80	8.4	NaOH, Na_2SiO_3		125	40		854
Goldfield		W	Z												700
Grinnell	M	W	Z	1941			513	85		NaOH*		1,000			5,210
Guttenberg	M	W	C	1939		A	324	176	7.8–8	CO_2		360	120	200	1,860
Hamburg	M	W	C		Yes	A	528	145	7.7			288	80	150	2,187
Humboldt	M	S	C	1933	No	Ps	299	85	7.8	CO_2		331	151	220	2,819
Indianaola	M	W	C	1933	Yes	Cr	250	65–90	8.2	CaO		700	220	340	4,123
Jefferson	M	W	C			Cr	445	291	8.6			502	150		4,088
Keokuk	M	R	C	1939	Yes	Cs	144	74	8.3–8.5	CO_2		3,000	1,300	1,724	15,076

Lake Park	M	I	Z	1938			342–522	85	8.0			115	50		828
Laurens	M	W	Z	1924	Yes	Cs	850	30	8.0	NaOH		136	45	80	1,304
Lohrville	M	W	C	1928		Cr	804	240	10.0			72	28		776
Madrid	M	W	Z	1941	No	Cs	368	85	7.6	NaOH		216	60	90	2,074
Marshalltown	M	W	C	1938		Cr	295	78	8.4	CO_2		4,000	2,500	3,000	19,240
Oskaloosa	M	W, R	C	1935	Yes	Cs	250–450	75–80	8.5	CO_2	(16)	2,000	750	1,000	11,486
Ottumwa	M	R	C	1932		Cs	200–425	85	8.2–8.4	CO_2		8,0000	3,624	5,400	31,570
Parkersburg	M	W	Z	1939			239	85	8.1	NaOH		200	48		1,260
Perry	M	W	C	1936	Yes	Ps	300	40–50	8.4			1,000	660	938	5,977
Persia	M	W	Z	1939	No	Cs	171	1	7.5	Na_2CO_3	(17)	29	5	10	1,273
Postville	M	W	C	1930		Ps	470	50				300	44	93	1,194
Renwick	M	W	Z												470
Shelby	M	W	Z	1940			462	85	8.4	NaOH		58	20		627
Shenandoah	M	W	C	1935	Yes	Ps	376	103–120	8.0	Na_2CO_3		1,500	500	1,000	6,846
Storm Lake	M	W	C	1936	Yes	Cr	667	200	8.6	CaO, CO_2		1,000	420	802	5,274
Traer	M	W	Z	1938	Yes		684	85		Na_2SiO_3, NaOH			90	120	1,493
Underwood	M	W	Z				300	85	8.4	NaOH		48	8		251
Whittemore	M	W	Z	1939			650	85	8.2	NaOH		24	15		671
Kansas:															
Beloit	M	R	C	1935		Ps	171–598	85–120	8.1–8.5	CO_2, Calgon		864	260	698	3,765
Chanute	M	R	C	1939–40	No	A	164–342	85	8.6	Calgon		3,130	824	1,175	10,142

* Also Elgin anti-corrosion treatment.

(15) One community outside of city.

(16) University Park, 462.

(17) Shelby, 627; Underwood, 251.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
Kansas—cont.															
Cherryvale	M	R	C	1939	No		250	92	8.4			1,000	250	400	3,185
Clyde	P	W	C	1937	No	Ps	325	86				432	90		1,060
Coffeyville	M	R	C	1935		Cs, Ps	80–300	85–100	8–9	Calgon	(18)	3,000	2,500	3,000	17,355
Council Grove	M	R	C		Yes	Cs	30–360	100	7.7–8.0	CaO		1,000	164	710	2,875
El Dorado	M	I	C	1937		Cs, Ps	154	70	9.2	CO_2		2,500	800	1,600	10,045
Erie	M	R	C	1933		Ps	198	84	8.4	CO_2		520	200		1,286
Eureka	M	I	C	1939		Ps	126		7.9	CO_2		864	250	360	3,803
Fredonia	M	R, I	C	1939		Cs, Ps	172	126	7.5	CO_2		1,550	450	800	3,524
Hanover	M	W	C	1934		Ps	272	103				288	33	55	896
Hoisington	M	W	C	1937	Yes	Ps	326	83	8.2	CO_2		750	250	458	3,719
Iola	M	R	C	1930	Yes	Ps	255	90	8.6	Calgon	(19)	2,000	740	1,159	8,225
Lawrence	M	R	C	1930	Yes	Cr, Ps	241	113	9.4	CO_2, Calgon		3,000	1,455	2,192	14,390
Lincoln	M	W	C	1932	Yes	Ps	272	40				500			1,761
Manhattan	M	W	C	1922	Yes	Ps	500	80	8	Na_2CO_3	(20)	3,000	1,800	2,700	11,659
Neodesha	M	R	C	1931	Yes	Cr	180	80	8.4	CO_2		2,000	700	1,000	3,376
Osawatomie	M	R, I	C	1939		Cr, Ps			8.4	CO_2		1,500	500	700	4,145
Pittsburg	M	W	C	1938	Yes	Cr, Ps	310	80	8.6	Nat. Gas, Calgon		3,000	1,850	2,450	17,571
Russell	M	I	C	1935		Cs	300–500	80–125	8	Calgon		1,000	450	1,032	4,819

Pittsburg	M	W	C	1938	Yes	Cr, Ps	310	80	8.3	Calgon		1,000	450	1,032	4,819
Russell	M	I	C	1935		Cs	300–500	80–125	8	Calgon					

Topeka	M	W, R	C	1921	Yes	Cr, Ps	205–445	85	9.4	CO_2, Calgon	(21)	10,000–12,000	5,000	8,900	67,853
Washington	M	R	C	1933	Yes	Ps	258	56	7.8–8.2	CO_2, Calgon		500	200	420	1,598
Wathena			C												860
Kentucky:															
Crab Orchard	M	W	Z	1939		Ps				CaO		43			705
Dixon	M	W	C	1940		Ps	450			CaO		57	57		642
Jenkins	P	S, W, R	C	1937	Yes	Cr, Ps						1,000			9,428
McRoberts*	P	W	C	1918–20		Ps				CaO		730	144	150	*2,146*
Owensboro	M	W	C	1929*41		Ps				CaO	(22)	3,110	2,800	3,600	33,245
Russellville	M	W	C	1924	No	Ps	300	55	9.5			400	140	160	3,983
Sturgis	P	R	C	1917		Ps	150		8.4	CaO	(23)	547	250		2,321
West Point	M	W	C	1939		Ps	342	85		CaO		360	360		992
Wheelwright*	P	*	C	1930		Ps	205–256	154–171	8.2	CaO	(24)	160	108		2,227

* Part of supply at McRoberts is mine water; Wheelwright has mine water supply.

(18) South Coffeyville; West Coffeyville.

(19) Gas City, 357; La Harpe, 624.

(20) Kansas State College.

(21) Suburban townships.

(22) C. C. C. Camp, 3,000.

(23) Four coal company locations, 190,000 gallons.

(24) 200 persons outside of city.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) *p.p.m.*	TAP WATER HARDNESS ($CaCO_3$) *p.p.m.*	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY *1,000 g.p.d.*	AVERAGE PRODUCTION DISTRIBUTED, 1939 *1,000 g.p.d.*	MAXIMUM PRODUCTION DISTRIBUTED, 1939 *1,000 g.p.d.*	TOTAL POPULATION SERVED
Louisiana:															
Addis	P	W	Z	1929				55					170		492
Algiers	M	R	C	1909		Ps	140–248	76–140	9.4	CaO		4,000	1,940	2,367	*
Arnaudville	M	W	C	1940		A			8.8	CaO		500	10		640
Colfax	M	W	C	1927		Ps	560			CaO		48	36		1,354
Destrehan	P	R	C	1921		Ps						400	198	281	*65*
Franklin	M	R	C	1927		Ps	150	80	8.6	CaO		1,000	400		4,274
Gretna	M	R	C	1935		Cr	180	85	8.8	CaO		2,225	820	1,126	10,879
Jeanerette	M	R	C	1940	Yes	A	380	170	8.9	CaO		500	150	210	3,362
East Bank, Jefferson Parish	M	R	C			Ps	150		9.9	CaO		4,000	1,100	1,500	
Lafayette	M	W	C	1929	Yes	A, Ps	130	116	8.2	CaO		1,500	1,650	1,850	19,210
Monroe	M	R	C			Ps			8.2	CaO		6,000	3,115	3,689	28,309
Mooringsport	M	R	C		Yes	Ps			6.8–7.4	CaO		72	20	40	748
Morgan City	M	R	C		Yes	Ps	100–140	100	7.8	Na_2CO_3	(25)	1,500	700	1,000	8,875
Newellton	M	W	Z	1932			310						30		789
New Orleans	M	W	C	1909		Ps	140–248	76–140	9.4	CaO		112,000	54,491	68,887	494,537
Norco	P	R	C	1938	Yes	Cs	103–137	51–85	9.3	CaO	(26)	430	110	200	
Opelousas	P	W	C	1940		Ps	200	120	8.8	CaO		1,500	1,200		8,980

Patterson	M	R	C	1916		Ps				CaO					1,800
Port Barre	M	R	C	1939		Ps				CaO		50			850
Port Sulphur	P	R	C	1935		P	216	130	9.4			300	75		
Reserve	P	R	C	1919		Ps	150	90	8.6	CaO		1,500	1,500		*475*
St. Joseph	M	W	Z					20					75		1,096
St. Martinville	P	R	C	1928			150	90		CaO		250	60		3,501
St. Rose	P	R	C	1921		Ps	150	90	8.8	CaO		250	45		*515*
Thibodaux	M	R	C	1930		Ps	150	80	8.6	CaO		1,000	190		5,851
Westwego	M	R	C	1922		Ps	150	80	8.2	CaO		1,000	350		4,992
Maryland:															
Chesapeake City			Z												
Fort Severn			Z												
Massachusetts:															
Winchester			Z	1941											
Michigan:															
Ann Arbor	M	W, R, I	C	1938	Yes		325	85	9.2	Calgon			4,500	8,000	29,815
Anvil Palms Location	P	R	C	1914		Ps	219	59	7.2			180	130		
Bay City	M	R	C	1937		Cs	185	85	9.0		(27)	14,000	4,800	10,000	50,346
Benton Harbor	M	W	C	1922	Yes	Cr, Ps	260–360	125	8.4	CaO	(28)	3,500	1,500	3,000	16,668

* Population included in population of New Orleans.

(25) Berwick, 1,906.

(26) Good Hope.

(27) Essexville, 2,390.

(28) Suburbs.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

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Michigan—cont.															
Blissfield			C												2,144
Coopersville	M	W	Z	1924	No	Cr	889	103				80	45	65	1,083
Dundee	M	R	C	1930	No	Ps	277	95	9.0	CaO		600	56	120	1,699
East Lansing*	M	W	Z	1933	No		330	330	7.3	Na_2SiO_3		1,800	500	1,400	5,839
Flint	M	R	C	1939		Cs	275	85	10.1			35,000	15,000	20,605	151,543
Flushing	M	W	Z	1939	No		660	180	8.4	NaOH					1,809
Frankenmuth	M	R	C	1939		Ps	338	129	9.1	Calgon		466	45	100	1,100
Grand Rapids†	M	R	C	1912	No	Cs, Ps	282	128	9.2		(29)	51,000	16,912	33,304	176,943
Lansing	M	W	C	1939		Cs, Ps	420	85	8.8			30,000	8,800	17,000	78,753
Midland	P	R	C	1926		Cs, P, Ps	175	40	8.6	CaOH, Calgon		4,000 to 5,000	200	4,050	10,329
Mount Morris	M		Z												*1,982*
Rockford	M	R	C	1927		Ps		211	8.9			694	189	416	1,773
Saginaw	M	R	C	1929		Cs, Ps	306	85	9.3			25,000	8,420	13,690	82,794
Ypsilanti	M	W	C	1939		Cs	380	80	9–9.2			2,225	1,280	2,165	12,121

Minnesota:															
Breckenridge	M	R	C	1938	No	Ps	340	85	8.6			1,000	200	350	2,745
East Grand Forks	M	R	C	1938		Cr	170	69	9.1	CO_2		1,000			3,511
Fergus Falls	M	R, I	C	1939	No	P	180–230	68	9.3	CaO		3,000	930	1,700	10,848
Grand Rapids	M	W	Z	1939			210	28	7.8			2,500	175		4,875
Granite Falls	M	R	C	1938		Ps	600–800					600	130	200	2,388
Hallock	M	R	C	1938	No	Cs						288	70	50	1,353
Little Falls	M	W	C	1936	No	Cr	275	100	7.4			1,500	700	1,200	6,047
Madison	M	W	C	1939		A	835	50	9.0	CO_2		130	100	120	2,312
Minneapolis	M	R	C	1941		P	175	75	9.0	Calgon		120,000	50,000	104,000	492,370
St. James	M	W	C	1941		Cr	600–1,000			CO_2		525	300		3,400
St. Paul	M	R	C	1939		Cr	174	70	7.4	CO_2		90,000	23,000	55,000	287,736
Sherburne	M	W	Z	1939			660	340	8.2			220	30		1,030
Staples	M	W	C	1939		P	228	76	10.6			576	108	342	2,952
Stephen	M	R	C	1940		A	300	140	10.0	Calgon		144	30		673
Mississippi:															
Natchez	M	W	C	1940		Cr, Ps	245	40	9.6	CO_2		3,000			15,296
Vaiden	M	W	Z	1940		Ps	128	50	8.4	$Ca(OH)_2$		100			601
Missouri:															
Appleton City	M	W	Z	1938	No			85				122	19	20	1,188
Bland	M	W	Z	1940			281	139				720	30	40	565
Boonville	M	R	C	1938	Yes	Cr	250	90	8.7	Nat. Gas		1,500	500	800	6,089
Blue Springs	M	W	C	1936		Ps	175	68				350	30	60	788

* Two plants.

† Changing to Lake Michigan for softer source.

(29) Paris, 6,237; Walker, 6,414.

Census of U. S. Municipal Water Softening Plants

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Missouri—cont.															
Carthage	M	W	C	1935		Cs	278	78	8.8	CO_2		2,000	650	1,082	10,585
Chaffee	M	W	Z	1940			420	68				300	50	100	3,049
Chillicothe	M	R	C	1930		Ps	80–300	100	9–9.5	CO_2, Calgon		1,500	600	885	8,012
Craig	M	W, R	Z	1939	Yes	P		101		Na_2CO_3		115	9	7	718
Crystal City	P	W	C	1927	Yes	P	293	68	7.9–8.2	CaO, CO_2		500	280	373	3,417
Fairfax	M	W	Z	1939			458	62				140	15	27	813
Gallatin	M	W	C	1938		Ps	402	159				150	75	90	1,642
Hermann	M	W	Z	1937	Yes	Ps	274	68			(30)	336	120	160	11,758
Hopkins	M	W	Z	1939		Ps	524	13					120	130	834
Houston	M	W	Z	1939	Yes						(31)	21	11	13	820
Jackson	M	W	C	1939		A	267	140				500	125	225	3,113
Jefferson City	P	R	C	1931	No	Cs, Ps	250	100	7.4–7.6	CaO, CO_2		3,000	1,000	2,000	24,268
Kahoka	M	W	C	1933		Ps	457	296				190	50	90	1,781
Kirkwood	M	R	C	1923	Yes	Ps	175	125	8.8	Calgon		2,000	625	1,300	12,132
Liberty	M	W	C	1922	Yes	Ps	379	125		$Ca(OH)_2$	(32)	500	341	485	3,598
Marshall	M	W	Z	1932	No	Ps	274	111	7.4			720	425	700	8,533
Mexico	P	W	C			Ps	306	152	8.6			1,000	600	700	9,053

Mexico	P	W	C												
Montgomery City	M	W	Z	1939	No		445	103				120	30	30	1,671
Mound City	M	W	C	1933		Ps	360	113				210	75	125	1,606
New Franklin	M	W	Z	1938			289	103		Na_2SiO_3		210	40	120	1,144
New Madrid	M	W	C	1939		Ps	179	185				300	150	200	2,450
Norborne	M	W	Z	1941											12,688
North Kansas City			C												
Oregon	M	W	Z	1935			616	85			(33)	160	55	80	1,526
Owensville	M	W	Z	1939	No								40		1,439
Pacific	M	W	Z	1939			302	84				280	35	90	1,687
Palmyra	M	S, R	Z	1939	No	Ps	291–325	78–85	7.9–8.2	CaO		300	126	159	2,285
Rockport	M	W	C	1934	Yes	Ps	598	133				144			1,406
St. Louis	M	R	C	1904		Cs, Ps	200	96	9.2			240,000	125,520	177,700	816,048
St. Louis County	P	R	C	1912		Cs, Ps	190	102	9.7		(34)	36,000	15,310	27,210	251,800
St. Mary's	M	W	C	1937		A	453	41				100	20	20	605
Ste. Genevieve	M	W	Z	1934			459	182				360	70	120	2,787
Salem	M	W	Z	1939			206	15				500	85	100	3,151
Salisbury	M	W	C			Ps		86	8.0				60	80	1,159
Spickard	M	W	C	1935		Ps	535					140	36	54	
Versailles	M	W	Z	1939			402	75				360	75	100	1,781
Weston	M	W	C	1930		Ps	433					140	45	75	1,121

(30) Ownesville, 1,439; Warrenton, 1,254; Washington, 6,756.

(31) Raymondville.

(32) One to three miles outside city limits.

(33) Forest City, 548.

(34) Arbor Terrace, 909; Bellerieve Acres, 132; Bel-Nor, 913; Berkeley, 2,610; Beverly Hills, 427; Brentwood, 4,341; Bridgeton, 169; Calverton Park, 139; Clayton, 12,861; Crystal Lake Park, 96; Des Peres, 641; Ferguson, 5,713; Florissant, 1,365; Glendale, 2,521; Glen Echo Park, 212; Grantwood Village, 86; Huntleigh Village, 168; Ladue, 3,976; Maplewood, 12,840; Margona, 286; Northwoods, 575; Oakland, 780; Olivette, 987; Overland, 2,880; Pasadena Hills, 837; Pasadena Park, 658; Richmond Heights, 12,754; Rock Hill, 1,794; Royal Oak, 147; Schuermann Heights (est) 450; Shrewsbury, 2,181; University City, 32,877; Velda Village, 495; Webster Groves, 18,343; Winchester, 108; Unincorporated areas, 125,500.

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Montana:															
Glendive	M	W, R	C	1935	Yes	Cr, Ps	85–445	34–85	9.4	CO_2		2,000	497	1,498	4,524
Miles City	M	W, R	C	1939	Yes	Ps	120–479	51	8.3	CaO		3,000	660	2,200	7,313
Nebraska:															
Falls City			C												6,146
Lyons	M	W	C	1939	No	A	316	81				346	158	270	1,033
Pawnee City	M	W	Z	1939	Yes	Ps	342	86–103	7.7			200	85	160	1,647
Superior	M	W	C	1924	Yes	Ps	342	210	7	CaO		720	300	300	2,650
Nevada:															
Boulder City (U. S. Reclamation Service)	U. S.	I	C			Cr	415	100	9.3	Calgon, CO_2		2,000	521	621	
New Jersey:															
South Orange	M	W	Z	1929	Yes		155	35	7.2			1,500	1,344	2,104	13,742
New Mexico:															
Gallup	M	W	C	1940	Yes	P	153	25	8.7	CaO		1,080	367	500	7,041

New York:																
(Town of) Bethiehem, Delmar, N. Y.	M	S, W	Z	1935–40	Yes		157	68				1,300	250	600	*400*
Dexter	M	W	Z	1937			200–1,000	80	7.3	NaOH		200	40		1,109
East Aurora	M	W	Z	1935			480	120	7.2		(35)	1,020	412	680	5,253
East Rochester	M	W	Z	1935	No		250	115	7.6–8.0	Na_2SiO_3		800	500	700	6,691
Elba	M	W	Z	1935	No	Ps	1,480	40				30	15	22	614
Ilion	M	R	Z	1939			265	103	7.6		(36)	800	1,368	1,807	
Palatine Bridge	M	W	Z	1937			280	90	7.9	NaOH, Na_2SiO_3		270	40	114	585
Sharon Springs	M	W, I	Z	1946					7.4				600	2,000	433
Thornwood	M	W	Z	1932			266	64	7.5			144	45	100	*462*
Union Springs	M	W	Z	1939	No		450	89				144	18	20	905
Utica*	M	S, R	Z				250	100	7.8			300*			100,518*
Yorktown Heights	M	W	Z	1932			200	100	7.7			100	37	53	3,642†
North Carolina:															
Elizabeth City	M	W	C		No	Ps	120	80	9.0	CaO, Calgon		2,000	500	700	11,564
Haw River	P	W	Z	1933	No		121					86	40	45	
Hertford	M	W	C			Ps	230	60	9.6	CaO, Calgon			100	140	1,959
Valdese			Z												2,615
Winterville	M	W	Z					20	8.2						*654*

* Only spring water softened—2 per cent of total supply.

† Figure represents population of Yorktown *town*.

(35) Surroundings.

(36) District #6, Town of Frankfort, 6,247.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
North Dakota:															
Bismark	M	R	C	1929	Yes	Cr, Ps	208	112	9.1		(37)	2,250	1,235	2,790	15,496
Fargo	M	R, I	C	1912 & 1932	Yes	Ps	320	108	8.6–9.0	Calgon, CO_2		10,600	6,169	3,250	32,580
Grand Forks	M	R	C	1931	Yes	Cs, P	233	91	8.0	$Ca(OH)_2$		4,000	1,400	2,540	20,228
Hazen	M	W	Z	1939		Ps				NaOH		110	40	110	662
Jamestown	M	W	C	1938		Cs	410	171	9.0	CO_2		2,000	490	1,390	8,790
Langdon	M	I	C	1939		Ps	125	56				288	35	45	1,546
Mandon	M	R	C	1939		Ps	265	100	9.0			2,000	500	1,120	6,685
New Rockford	M	W, R, I	C	1933	Yes	Ps	368	60				200	50	90	2,017
Ohio:															
Ada	P	W	C	1936	Yes	Ps	499	100				500	102	160	2,368
Adena	M	W	C	1939	No	Ps	554	102	8.9			144	22	25	1,703
Alger	M	W	C	1936	No	Ps	550		10.2	CaO		108	15	15	811
Arcanum	M	W	Z	1940											1,188
Ashland	M	R, I	C	1941		P	154		7.5			1,500	800		12,453
Ashley	M	W	C		No	Ps	350	70	8.0	Na_2CO_3, Calgon		100	23		762
Baltimore	M	W	C	1936	No	Cr	262	85	8.7	CaO, CO_2, Calgon	(38)	144	32	75	1,601

Batavia	M	R	C	1913	Yes	Ps	60–200	50		CaO		100	75	100	1,320
Beach City	M	W	C	1937	Yes	Ps	313	183	8.2			250	80	110	812
Belle Center	M	W	C	1939		A	427	137	8.9			210	13		835
Berea	M	R, I	Z	1937	No	Ps	238	85	7+	CaO		1,200	410	506	6,025
Bloomdale	M	W	C	1937		Ps	889	855*	8.6			110	14		575
Burton	M	W	Z	1930			162	68	7.0	Calgon		60	27		761
Cadiz	M	W	C	1939	No	Ps	414	65	8.2			500	130	165	2,808
Caldwell	M	R, I	C†		Yes	Ps	90–126	70–90	7.5			415	125	180	1,705
Canal Winchester	M	W	C	1934	Yes	Ps	400	65	8.6	CO_2, Calgon		288	40	50	1,046
Centerburg	M	W	C	1936	No	Ps	275	69	9.8	CO_2, Calgon		288	30	68	779
Centerville	M	S, I	C	1938	No	Ps	242	106	9.0			324		170	113
Chillicothe	M		C												20,129
Columbiana	M	W	C	1939		A	291	68		Calgon		350	135		2,687
Columbus	M	R, I	C	1908		Ps	266‡	92§	9.8	Calgon	(39)	54,000	32,600	44,900	328,193
Cuyahoga Falls	M	W	Z	1936		Ps	256	63	7.5		(40)	4,000	1,314	1,945	21,188
Defiance	M	R	C	1921		Ps	259	104	9.2	Calgon		2,000	753	1,330	9,744
Delaware	M	R	C	1921	No	Ps		85–100		Calgon		2,000	773	1,047	8,944
Delta	M	I	C	1930	Yes	Ps	90	40	8.4	Calgon		1,000	80	120	1,773
Dillonvale	M	W	C	1939		Ps	821	205	10.2	Calgon	(41)	186	60		2,369

* Little hardness reduction; treatment primarily to reduce fluorides.

† Jeffrey Floctrol System.

‡ 30 years: mean ave. max. 501, mean ave. min. 41, mean ave. 266.

§ 30 years: mean ave. max. 467, mean ave. min. 52, mean ave. 92.

(37) Fort Lincoln; State Penitentiary.

(38) Basil, 766.

(39) Bexley, 8,705; Gahanna, 425; Grandview Heights, 6,960; Hanford, 223; Marble Cliffs, 331; Riverlea, 92; Upper Arlington, 5,370.

(40) Silver Lake Village, 642.

(41) Mount Pleasant, 717.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
Ohio—cont.															
Edgerton	M	W	Z	1938			308	32	9.1	$NaOH, Na_2SiO_3$		180	26	87	1,082
Elmore	M	W, I	Z	1934			1,250	110	7.8	Na_2SiO_3		200	45	60	1,103
Findlay	M	S, W, R	C	1931	Yes	Cs	345	86	9.0			4,000	1,521	2,086	20,228
Forest	M	W	C	1939	Yes	Ps	496	93	8.9	CO_2		144	19	34	1,083
Fort Recovery			C												1,123
Fostoria	M	W, R, I	C	1929		Cs	250	100	8.7	Calgon		3,000	1,600	1,885	13,453
Frankfort			C												839
Franklin			C												4,511
Fremont	M	W	C	1928		Cs	287	97	8.9	CO_2		3,000	960	2,080	14,710
Gallipolis	M	W	C	1930		Ps	256	85	9.0			1,500	750		7,832
Genoa	M	W	Z	1932	Yes	Ps	388	85				144	46	78	1,455
Georgetown	M	R	C	1937		Ps	136	85		Calgon		230	50		1,848
Girard	M	W	C	1922	Yes	Ps	240	100	8.7	CaO		1,000	440	780	9,805
Glendale	M	W	C	1924		Ps	300	68	9.2	Calgon		600	205	500	2,359
Glouster	M	W	C	1929		Ps	325	68	10.0	Calgon			440	60	2,847
Grafton	M	W	C	1934	No	Ps	230	90				72	45	69	971
Granville	M	W	C	1939	Yes	Ps	393	91		Calgon		300	150	190	1,502

Granville	M	W	C	1939	Yes	Ps	393	91		Calgon		300	150	150	1,032

Green Springs	M	W	Z	1939	No		527	124	7.8	Na_2CO_3		200	25	45	930
Greenville	M	W, R	C	1925	No	Cs, Ps	445	85–90	8.6			3,000	463	897	7,745
Greenwich	M	W	Z	1939	No	Ps	272	73	9.3	NaOH, Na_2SiO_3		85	32	48	996
Grove City	M	W	Z	1935	No		598		8.5			210	85	70	1,787
Hamilton	M	W	C	1936	No	Cr	316	85	8.4–8.7	CO_2	(42)	6,000	4,200	5,800	50,592
Hebron	M	W	C	1937		Ps	376	85				140	16		723
Holloway	M	W	C	1939		P	136	68	8.2			140			733
Hudson	M	W	C	1931	No	Ps	510	100	9.6	CO_2, Calgon		400	142	202	1,417
Jacksonville	M	W	C	1939		Ps	320	108				72	11	15	812
Jeffersonville	M	W	C	1938		P	376	103	9.9			110			785
Johnstown		W		1936		Ps	427	68	10.0			140	30		1,064
Kent	M	W	C	1930	Yes	P	231	77	9.6	Calgon		1,500	750	1,060	8,581
Kenton	M	W	C			Cr, Ps	508	81	8.9			1,500	358	540	7,593
Kingston			C												864
Lancaster	M	W	Z	1933	Yes	Ps	360	82	8.1	Na_2CO_3		3,000	1,250	2,000	21,940
Leesburg	M	W	C	1936	Yes	P	390	110	7.5	CaO		300	18	50	839
Leroy	M	W	C	1927	No	Ps	567	55	9.5			100	20	51	254
Lowellville	M	W	Z	1927	Yes		324	85	7.3			300	112	150	2,359
Marietta	M	W	C	1939		P	260–320	65–96	9.2–9.6	CO_2		2,800	1,535	2,110	14,543
Marion	P	W	C	1928		Cr	735	188	9.2			5,000	1,200		30,817
Marysville	P	R	C	1929		Cs	308	85	9.1	Calgon		660	325		4,037
Massillon	P	W, R	C	1931	Yes	Ps	370	95	8.6			3,500	1,600	2,390	26,644
McDonald	P	S, W	C	1922		Ps	210	100		CaO		1,000	350	450	1,529
McGuffey	M		C												618
Medina	M	W, R	C	1917	No	Ps	241	80	9.3	CO_2		1,000	441	838	4,359
Mentor	M	W			Yes	P	205	102	8.0			150	43	90	1,827

(42) Two suburbs, very small.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

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Ohio—cont.															
Mechanicsburg	M	W	Z	1931			378	34	7.1	Na_2CO_3			35	95	1,653
Milford	M	W	C	1936	Yes	Ps	381	90		Calgon		1,000	112	250	2,139
Mineral Ridge*	M	I, R	C	1932		Cr	120	78	10.4	Calgon	(43)	40,000	14,000	18,000	199,000
Monroeville	M	R	C	1938		Ps	350	90	8.9	CaO		500	75	100	1,173
Montpelier	M	W	C	1940		P	330	80	9.4	Calgon					3,703
Mount Sterling	M	W	C			Ps	445	103	10.2	Calgon		230			1,115
Mount Vernon	M	W	C	1936			359	68.4		Calgon		2,100	1,400		10,122
Mount Victory	M	W	C	1937		Ps	479	120	9.7	Calgon		110			645
New Bremen	M	W	Z				564	57					260	394	1,484
New Holland	M		C												777
New London	M	S, W	Z	1937			346			$NaOH$, Na_2SiO_3		200	75	125	1,656
New Madison	M	W	C	1937	Yes		366					50	15	18	616
New Philadelphia	M	W	Z	1935	Yes		400	72	7.7–8.1	Na_2CO_3		1,500	905	1,754	12,328
New Richmond	M	W, I	C	1927	Yes	Cr		85	9.8	Calgon		600	78	100	1,767
New Washington	M	R, I	C	1938		Cr	240	100	8.9			144	19	33	857
Newark	M	R	C	1923	Yes	Cr, Ps	240	70	8.6–9.0	CO_2, Calgon		6,000	4,200	5,200	31,487

North Baltimore	M	W	Z	1937	No		743	59	8.8	Na_2SiO_3, NaOH		300	65	90	2,616
Oberlin	M	R	C	1903	No	Ps	350	65	9.0	Calgon		1,000	375		4,305
Orrville	M	W	C	1939		Cr	275	72	9.8			600	280	402	4,484
Pataskala	M	W	C	1939	No	A	324	76–90	9.6–9.8			144	18	25	824
Pemberville	M	W	Z	1936	Yes		390	76	8.0	Na_2SiO_3, NaOH		60	36	45	1,036
Piqua	M	R, I	Z	1926		Cs, Ps	216	57	10.0	Calgon		5,000	1,550	2,213	16,049
Plymouth	M	W	Z	1934	No		616	85	7.8	Na_2CO_3			90		1,403
Reading	M	W	C	1934	Yes	Ps	400	80		CO_2, Calgon		900	450	700	6,079
Rio Grande	M	W	C	1938		Ps	171	85	9.2	Calgon		70	8		204
Rittman	M	W	Z	1935	No	Ps	200	80	7.9	NaOH		550	180	235–356	2,770
Roseville	M	W	C	1933	No	Ps		85	8.8			250	50	80	1,320
St. Clairsville	M	S	C	1929	Yes	Ps	150	80–85	8.9	$Ca(OH)_2$		500	77	100	2,797
Seaman	M		C												726
Seville	M		C												850
Shelby	M	W	C	1939		P	718	120	9.8			2,000	600		6,643
Sunbury	M	W, I	C	1930	No	Ps	320	70	8.2			125	20	60	846
Swanton	M	I	C	1939	No	P	110	61	8.5			300	75		1,594
Sylvania	M	W	C	1939	Yes	P	513	95	9.0			288	100	250	2,199
Toronto	M	R	C	1937		Ps	103	85				1,000	300		7,426
Troy	M	W	C	1936		Cr, Ps	320	58	9.6			2,250	900	1,300	9,697
Upper Sandusky	M	R	C	1936		Ps	291	85	8.7			1,000	250		3,907
Wapakoneta	M	W	Z		Yes		427	53					465	750	5,225
Warren	M	R	C	1938	No	Cr, Cs, Ps	139	84	8.9			8,000	3,850	4,923	42,837
Waterville	M		C												961
West Jefferson	M	W	C	1939		P	445			Calgon		230			1,386

* Mahoning Valley Sanitary District.

(43) Niles, 17,000; Youngstown, 182,000.

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Ohio—cont.															
West Liberty	M		C												1,228
West Mansfield	M	W	C	1939		P	640	136	8.8–9.4	CO_2			12	20	739
West Milton	M		C												1,439
West Union	M	R	C	1939			140	85				230	20		1,334
Westerville	M	R, I	C	1924	Yes	Ps	300	85	10.2	Calgon		600	200	300	3,146
Williamsburg	M	R	C	1936	Yes	Ps	175	120				324	30	34	1,194
Woodville	M	W	C	1939	Yes	Ps	445	84	9.3	CO_2, Calgon		288	63	82	1,219
Wooster	M	W	C	1935	Yes	Cs	240	75	9.4	CO_2		2,000	908	1,350	11,543
Worthington	M	W	Z		Yes		393	65	7.6	NaOH			100	155	1,569
Wyoming	M	W	C	1931		P	452	68		CO_2, Calgon	(44)	1,000	700	1,000	11,289
Yorkville	M	W	C	1939		Ps	684	171	10.0	Calgon		450	60		1,961
Oklahoma:															
El Reno	M	W	C	1941	No	A	375–400	120	8.4		(45)	3,000	1,485	1,760	10,078
Oklahoma City	M	I	C	1923	Yes	Cr, Ps	150–200	85–100	9.5	CaO		16,000	16,000	28,000	204,424
Paul's Valley	M	W	C	1937	No	A	533	93	Very high			864	200		5,104

Pennsylvania:																
Ambridge	M	W	Z	1934	No		285	70	7.3		(46)	1,800	1,450	1,800	19,814
Avella			C												*1,520*
Bellevue	P	W	Z	1925	Yes		230	85	7.2		(47)	7,200	4,000	5,400	71,033
Braddock	M	R	C	1937	No	Cs, Ps	40–250	75–150	8.8–9.3			3,600	1,300	1,500	18,326
Brave	P	R	C	1922	No	P	51–137	17	9.6			24	12		*467*
Carrick	P	R	C	1924	Yes	Cs, Ps	502–550	50–100	7.3	CO_2, $Ca(OH)_2$	(48)	30,000	18,000	21,000	319,152
Cheswick	M		Z	1941											1,241
Coalport	M	W	C	1931	Yes	A	280	80	9.0				52	52	1,121
Cokeburg	M		C												1,415
Coraopolis	M	W	Z	1936	Yes		150–310	60	7.5–7.7	Na_2SiO_3	(49)	1,500	950	1,279	11,086
Edgeworth	P	W	Z	1936	No		195	85	7.6		(50)	1,500	350	820	4,028
Ford City	M	W	C	1924	No	P	335	70			(51)	2,000	340	468	8,567

(44) Arlington Heights, 1,222; Lockland, 5,601.

(45) U. S. Southwestern Reformatory.

(46) Harmony Township, 846.

(47) Avalon, 6,155; Ben Avon, 2,516; Ben Avon Heights, 393; Emsworth, 2,765; Kilbuck Township, 1,772; McKees Rocks, 17,021; Neville Township, 1,469; Ross Township, 10,827; Stowe Township, 12,577; West View, 7,215; Part of Pittsburgh.

(48) Parts of the 16th (28,826), 18th (22,029), 19th (43,399), 20th (24,595), 28th (9,121) Wards and all of the 29th (16,700), 30th (7,898), 31st (6,176), 32nd (6,282) Wards of the City of Pittsburgh: the Boroughs of Brentwood, 7,552; Bridgeville, 4,459; Carnegie, 12,663; Castle Shannon, 3,970; Crafton, 7,663; Dormont, 12,874; Greentree, 1,880; Hiedelberg, 2,239; Ingram, 3,904; Mount Oliver, 6,981; Munhall, 13,900 (part only, the remaining part being supplied by the Borough with water purchased from the company); Rosslyn Farms, 432; Thornburg, 284; West Homestead, 3,526; Whitaker, 2,217: the Townships of Baldwin, 7,723; Bethel, 5,966; Collier, 7,685; Jefferson, 5,585; Mifflin, 8,694; Mount Lebanon, 19,571; Scott, 6,297; Snowden, 4,399; Upper St. Clair, 2,486; and other territory adjacent to the above municipalities.

(49) Moon.

(50) Leetsdale, 2,332; Fair Oaks.

(51) Bellewood Garden, 2,772.

Census of U. S. Municipal Water Softening Plants

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Pennsylvania—cont.															
Fox Chapel Borough	M	R	C	1939		Cs, Ps	60–106	70–80	7.8–8.0	CaO, Calgon	(52)	500			1,080
Grove City	M	W	C	1928	No	Ps	218	64	9.3	Calgon		2,000	399	703	6,296
Hastings	M	S	C	1939	Yes	P	787	137	10.2	Calgon		180			2,105
Hooversville			C												1,364
Jenners			C												*1,500*
Jonestown			C												
Kissinger Mills	P	W	Z	1933			210					5			*±400*
Library			C												*1,500*
Leola	P	W	Z	1939			284	15	7.5		(53)	80	8	12	*210*
Lowber			C												*430*
McKeesport	M	R	C	1908	Yes	Ps	124	108	9.0	CaO	(54)	10,000	6,000	7,500	67,668
Manheim Twp	P	I	Z	1931			220	60			(55)	432	150	164	13,761
Maxwell			C												*28*
Millersville	M		Z	1941											
Oakmont			C							Calgon					6,260
Pittsburgh (See Carrick, Pa.)															

Richeyville			C												*2,000*
Saltsburg	M	R, I	C	1926	No	Ps	200	80	8.0			1,400	98	100	1,097
Sewickly	M	W	Z	1929			210	65	7.9	NaOH	(56)	1,750	750	1,750	8,587
Shaler Twp.	M	W	C	1940		P, Ps	161–180	95–105	9.5	CaO		500			11,185
Somerset	M	W	Z	1936			188	51	7.8	Calgon		720	360	500	5,430
Springdale	M	W	Z	1928	Yes	Ps	256	40	7.5			500	150	180	4,989
Tarentum	M	R	C	1935	No	Cs			8.6	CO_2	(57)	2,000	700	900	13,362
Upper Leacock Twp.	P	W	Z	1939			300	60			(58)				4,993
Verona	P	R	C	1934		Ps	60–150	70–180	7.1	CaO	(59)	3,500	1,950	3,100	29,639
Washington	P	I	C	1932		Ps	158	67	9.1			3,000	2,900		26,166
Wendel			C												*800*
West Kittanning		W	Z				479	137				180	27	27	1,005
West Newton	P	S	C	1929		Ps		100		Na_2CO_3	(60)	288	100		11,968
West Pittsburgh			C												
South Carolina:															
Mount Pleasant	M	W	Z	1939			222	51	7.5			202	50		1,698
Orangeburg	M	W	C	1937	Yes	Cs, Ps	125	40	8.9	CaO		1,000	477	648	10,521
St. Stephens			Z												1,185
Sullivan Island			Z												*±300*

(52) Parts of Harmar, Indiana, O'Hara Townships.
(53) Bareville; Leacock, 2,329.
(54) Liberty, 1,084; Port Vue, 3,601; Versailles, 2,401; Versailles Township, 5,227.
(55) Lancaster Township, 6,151.
(56) Parts of Edgeworth (1,696) and Osborne (529); Sewickley Heights, 748.
(57) East Deer Township, 3,516.
(58) Bareville Village; Leacock, 2,329; Leola.
(59) Harmony, 846; Indiana Township, 10,050; Oakmont, 6,260; Penn, 1,081; Plum, 7,046.
(60) Part of Rostraver Township, 9,203.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
South Dakota:															
Aberdeen	M	I	C	1935	Yes	Ps	120–400	68	9.1–9.6	CO_2		4,000	2,000	3,100	17,015
Beresford	M	W	C	1936	Yes	Ps	479	85–103				100			1,642
Mitchell	M	R, I	C	1928	Yes	Ps	410	270	8.8–9.2	CaO, $NaAlO_2$		2,000	1,280	2,300	10,633
Mobridge	M	R	C	1936	Yes	Cr, Ps	170	50	9.4	CaO, Polyphosphate		750	115		3,008
Vermillion	M	W	C	1929	Yes	Ps	735	103	10.2	CaO		500	310	516	3,324
Yankton	M	R	C	1928	Yes	Ps	171–342	85			(61)	2,000	900	1,000	6,798
Texas:															
Abilene			C							Calgon					26,612
Bellville	M	W	Z	1935	Yes	Ps	222					300	80	120	1,347
Brenham	M	S, W	C	1924	Yes	Ps	550	205	8.8–9.0	CaO		1,000	330	560	6,435
Corsicana	M	I	C	1931	Yes	Ps	177	84	9.0		(62)	3,000	1,038	1,500	15,232
Dallas	M	I	C				130	50–70	10.0	Calgon		60,000	27,000	54,000	400,000
Georgetown			C												3,682
Glidden*	P	W	Z	1930	Yes		263	28	8.1			250	250	250	*360*

Hico	M	W	C	1929	Yes	Ps		321	8.0	CaO		150	40	60	1,242
Huntsville	M	W	Z	1931–34	Yes	Ps	152	46	7.6		(63)		362	539	5,018
Lockhart	M	S	C	1940		Ps	769	342	9.0			1,440	271	335	5,018
Stamford	M	R, I	Z, C	1935	Yes	Cs	308–684	137–205	9–10		(64)	1,000	700	950	4,810
Temple	M	R	C	1939		P, Ps	120–250	55–80	6.5–7.0			3,000			15,344
Three Rivers	M	W	Z	1936	Yes	Ps	25	171				200	90	50	1,337
Trinidad			C												*600*
Wichita Falls	M	I	C			Ps	260	268	8.2–8.4			5,500	3,965	7,590	45,112
Virginia:															
Ampthill			Z												2,133
Blacksburg			Z												*±300*
Boissevain			Z									300	70	80	993
Bridgewater		S	Z	1937	No		225								9,768
Bristol			C												
Catawba Sanatarium			C									30	15	35	576
Dublin		W, I	Z	1927	Yes	Ps							50	75	*±100*
Natural Bridge	P	S	Z	1927	No	Cs	3.4	3.4							*±300*
Woodberry Forest			Z												

* Very small part for domestic use; primarily for railroad use.

(61) Sacred Heart Hospital; State Institution.

(62) State Orphan Home; Zion's Rest.

(63) C. C. C. Camp; Texas State Prison System.

(64) Avoca; Leuders.

Census of U. S. Municipal Water Softening Plants

(See key at beginning of tabulation)

STATE AND TOWN	OWNERSHIP	SUPPLY	TYPE PLANT	YEAR INSTALLED	DECREASE IN COSTS	TYPE BASIN	RAW WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER HARDNESS ($CaCO_3$) p.p.m.	TAP WATER pH	CHEMICALS USED IN pH CONTROL, IF ANY	ADDITIONAL COMMUNITIES	RATED DESIGNED MAXIMUM CAPACITY 1,000 g.p.d.	AVERAGE PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	MAXIMUM PRODUCTION DISTRIBUTED, 1939 1,000 g.p.d.	TOTAL POPULATION SERVED
Washington:															
Coulee Dam	U. S.	S	Z	1937	Yes		140	25	7.4			40	20	22	744
West Virginia:															
Berwind	P	W, R	C	1929	No	Ps	68–137	8–26	9.4			875	400	600	*2,900*
Clarksburg	M	R	Z	1939		Ps	30–170	40–85	8.3–9.0	CaO		6,000	3,000	3,500	30,579
Grant Town	P	R	C	1937	Yes	Ps	34–103	17–51	9.0			250	150	190	*7,737*
Holden	P	W, R	C	1930		Ps	300					864			*3,000*
Lochgelly	P	R	C	1941		P	300	100				86	60		*±500*
Minden		R	Z	1925											*1,500*
Morgantown	P	R, I	Z	1936		Ps	40–300	60		CaO	(65)	1,440			27,000
Mount Hope	M	W	C	1920		Ps						432			2,431
Parkersburg	M	W	Z	1939	Yes	Cs		75	8.4	CaO	(66)	4,000	2,700	3,600	30,103
Wellsburg	M	W	Z	1933	Yes	Ps	222	111	7.4			500	300	480	6,255
Williamstown	M	W	Z	1939	No	Ps	240	70–100	7.5			50	40		1,687

Wisconsin:															
Antigo	M	W	C	1939	Yes	A	145	74	8.8			2,000	600	750	9,495
Cambridge	M	W	Z	1941											577
Colby	M	W	Z	1941											903
Columbus	M	W	C	1933	No	Cs	340	50	8.4			1,000	200	330	2,760
Elkhorn	M	W	C	1939	Yes	P	308	80	8.7	CO_2		1,000	189	500	2,382
Evansville	M	W	C	1933	No	Ps	315	58	9.4			720	139	318	2,321
Galesville	M	W, I	Z	1935	No	Ps	222		7.6	Na_2SiO_3, NaOH		140	38	140	1,147
Greendale	M	W	Z	1937		Ps	479	103	7.2			1,000	150	750	2,527
Hilbert	M	W	C	1940		P	312	80							607
(Town of) Lake	M	W	Z	1939			400–425	102	7.8–7.9			1,150			*10,548*
Lomira	M	W	Z	1939			520	222	7.0			288			659
Manawa	M		Z												791
Neenah	M	R	C	1936	No	Ps	165	64	8.7			2,000	585	1,122	10,645
Pardeeville	M	W	Z	1941	No		269	85		NaOH, Na_2SiO_3		216	15	8	1,001
Platteville	M	W	C	1938		Cs	305	45–50	8.6–8.8			1,000	200	475	4,762
Poynette	M		Z												870
Sheboygan Falls	M	W	Z	1939			787	94	7.3			700	230	335	3,395
Waupun	M	W	C	1935	No	Cs	300	50				1,000	259	562	6,798
Williams Bay	M	W	C	1938	Yes	A	420	100	9.6			820			717

(65) Total population served, 27,000, including communities outside of city.

(66) South Side, Parkersburg.

Machinery Breakdown Insurance

By A. F. Graham

THE requisites for the protection of power plant equipment may be divided into four main classes: (1) sound design, construction, and installation; (2) intelligent operation and maintenance; (3) adequate inspection; and (4) proper insurance coverage. Before going into the technical phases of engineering and inspection, in which power plant men will be most interested, however, it will be well to give briefly the history and development of boiler and machinery insurance and some idea of the coverages available.

Eighty years ago there was started what is believed to have been the first corporate "safety" movement in the United States. The movement resulted from a study of the causes of boiler explosions by members of the Polytechnic Club of Hartford, Conn., after a series of disastrous explosions in New England had made the subject one of deep concern to the industries there. In those days the general public looked upon this catastrophe as of somewhat mysterious origin, but, as a result of the studies, this group of engineers concluded that most boiler explosions were due to very definite conditions or defects which could be detected in the incipient stages by men trained for that work. Some of the members of the group reached the conclusion that they could establish a regular inspection service for detecting accident-producing conditions, and could, for a small charge, guarantee their service by affording insurance loss up to such amount as the client chose to select as the policy limit. To provide this guarantee in a legal and proper way the Hartford Steam Boiler Inspection and Insurance Co. was organized in 1866.

The complete success which attended this endeavor to reduce the number of boiler accidents resulted in the establishment of an inspec-

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tion service and insurance coverage to prevent or to compensate for losses arising from the explosion of flywheels on steam engines, then the prime movers for most industries. Again the accident prevention service was found to be most effective, the experience in the inspection of flywheels being of such character that the reduction of the number of flywheel accidents also prevented many other types of accidents to which the machinery was subject.

As a result of these first applications inspection and insurance were eventually made available for the entire steam engine unit. Later, the explosion of a steam turbine brought about a demand for inspection and insurance in connection with this new prime mover and the increasing use of electrical machinery brought with it a demand for effective accident prevention service on this type of apparatus too. Inspection service and insurance on electrical equipment was finally made available in about 1922.

Insurance Against Direct Property Damage

Today, power plant insurance is divided into two main classes: *boiler insurance* which covers boilers and pressure vessels, including refrigerating systems; and *machinery insurance,* which covers all classes of wheels, engines, turbines, pumps, compressors, and electrical equipment, and some classes of miscellaneous machines such as small refrigerating and compressing machines, enclosed gear sets, paper machines, hydraulic transmissions, etc. The actual insurance policy form is the same for both classes, its application to the particular objects under consideration being provided for by attaching to the policy form the type of accident to which the coverage applies.

With respect to boiler insurance, in general, the basic accident insured against is the sudden and accidental tearing asunder of the object or parts thereof due to internal pressure of the vessel contents. In machinery insurance the basis accident is "a sudden and accidental breaking, deforming, burning out or rupturing of the object or any part thereof, which manifests itself at the time of its occurrence by immediately preventing continued operation or by immediately impairing the functions of the object, and which necessitates any repair or replacement before its operation can be resumed or its functions restored." This definition is intended to include the usual operating accidents which are sufficiently serious to manifest themselves at the time of their occurrence, but to exclude occurrences of the kind for which repair would normally be recognized as a matter

of maintenance. It is assumed that any breaking, deforming, burning out or rupturing that is not sufficiently serious to make itself manifest at the time of its occurrence is an item of maintenance and is not one for insurance protection. In addition to these qualifications the definition provides that the breaking, deforming, burning out or rupturing must be sudden and accidental. Slowly developing cracks and other defects which appear gradually and which are discovered before they cause a sudden and accidental breaking are not contemplated as accidents under this class of insurance.

The direct damage property insurance policy, applying to either boilers or machinery, primarily undertakes to reimburse the policyholder for loss sustained on property of his own which is damaged by an accident of the sort covered by the policy and to cover for him also such liability as may accrue to him from loss on property of others damaged by the accident. At his option, however, the policyholder may also include in his direct damage policy a provision that will make insurance funds available for providing overtime work by repair men, for making temporary repairs and for meeting the extra cost that would arise from the use of special means for hastening the transportation of needed repair parts. This provision is called "expediting" coverage. In a similar way, at the policyholder's option, personal injury liability (for both the public and employees), except that which would be covered under a workman's compensation law of the state in which his plant is located, may also be included.

Indirect Property Loss Coverage

What has just been described concerns direct property loss resulting from power plant accidents. Another type of loss, however, is frequently sustained by the plant owner when an accident to his power equipment occurs. This is referred to by insurance men as an "indirect loss." To provide coverage for indirect losses there are available, as endorsements to direct damage policies, three different forms of protection: (1) "use and occupancy," (2) "outage," and (3) "consequential damage."

Use and occupancy coverage is intended to apply to loss resulting from the reduction or stoppage of income from the business normally conducted on a specified premises. On the other hand, in some plants, there are machines whose relation to the process is such that an accident to them would cause no stoppage of production or loss of income, but would increase the normal cost of doing business. *Outage*

insurance is designed to cover the loss arising from this increase in the cost of operations necessary for carrying on business. *Consequential damage* insurance applies to the indirect damage to property resulting from lack of heat, light, power, steam, or refrigeration; e.g., it would apply to such cases as the freezing of flowers in a greenhouse deprived of heat by a boiler accident, or to the spoilage of goods in cold storage because of an accident to refrigerating equipment.

The foregoing comments have covered briefly the kinds of objects insured, the types of accidents insured against and the various kinds of insurance coverage available for protection of power equipment, but there is another aspect of the subject which is probably of more direct interest.

Values of an Inspection Program

It arises from the fact that the activities associated with power plant insurance are, by nature, perhaps 80 per cent engineering and only 20 per cent underwriting. Boiler and machinery insurance differ greatly from all other forms of insurance, the difference lying principally in the fact that its basic aim is, by means of well regulated inspection service, to reduce the number of accidents producing the losses for which it has to pay. It may be of interest in this connection to point out that the cost of the inspection service for some classes of equipment is as much as 45 per cent of the premium charged for their coverage.

This accident-prevention program ranks ahead of all other phases of the business from the standpoint of both the company and the policy-holder; it has done so ever since the first company was organized. Thus, it is obvious that a great part of the value of power plant insurance to the policyholder hinges on the nature and quality of the engineering and inspection service accompanying it.

The question of whether any boiler and machinery insurance company can justify spending so much of its premium income for inspection service often arises. It is not only reasonable to assume that the answer is "yes," but statistics very definitely prove that such use of this large part of the premium income has prevented accidents from which the losses would have, at least, equaled, and most probably would have exceeded greatly the cost of prevention. These records definitely show that wherever insurance inspection of power plant equipment has been afforded, the frequency of accident has decreased. During the first year or two after inspection service was

afforded on electrical machines, for instance, the accident frequency was 1:9.5, meaning that, on the average, one in every nine and one-half machines suffered an accident each year. As the insurance engineers gained experience in this particular line and were able to perfect the accident prevention service, the accident frequency was gradually improved until in 1939 (the latest year for which complete figures are available) it was 1:26.3.

These figures are concrete evidence that there are fewer accidents to insured equipment than to uninsured equipment, yet, occasionally, owners and operator feel that if they have equipment which is properly designed, constructed, and installed and good engineers, thoroughly familiar with the equipment, the insurance inspector can offer nothing that they do not already have. Insurance companies have never claimed that insurance engineers are more competent on matters of operation than are operating engineers and others in supervisory charge of industrial plants, nor have they claimed that insurance engineers are more competent designers of power plant equipment than are the manufacturers. It is known beyond any possible contradiction, however, that insurance engineers are more experienced and better equipped than either of these groups from the standpoint of detecting accident-producing conditions. It is realized that no field insurance engineer is any more effective than the organization behind him, but that with a substantial organization supplying him with information and supervising his work, he has the benefit of broad experience with respect to accidents to all kinds of power plant equipment operating under a wide variety of conditions. This accident-prevention service is not a hit-or-miss undertaking, but one based on actual facts and statistics. In this same connection it may be pointed out that an insurance engineer is not guided entirely by codes or standards, but, to a great extent, by his company's knowledge of the things which have been found by experience, over a period of years, to produce accidents to a given type and design of apparatus under certain operating conditions. In gaining experience, for instance, the inspectors of the Hartford Company made a total of 697,941 object inspections during the year 1939.

In addition to collecting and correlating the experience gained inside the organization from studies of accidents and from making hundreds of thousands of inspections each year, the home office organization familiarizes itself with general power plant operating problems. Thus it is not uncommon to find home office representa-

tives of the companies on committees of various engineering organizations responsible for standards in connection with construction, installation and operation of power plant equipment. These engineers also take the initiative in research work designed to determine and correct the most frequent causes of accidents. All of the results of the research work on the part of a company equipped to handle research are transmitted to its field engineers to increase the effectiveness of their work in the interest of both the company and the client.

Experiences in Accident Prevention

It might be well to cite here some examples of the manner in which this accumulation of experience affects the public by preventing or reducing accidents that would have contributed to economic waste had they occurred. Such accidents may be among those classified as preventable by the highly specialized insurance service that recognized the early symptoms of trouble and was in a position to prescribe the proper steps for avoiding it. In connection with steam type engines, pumps, and compressors, the inspector is often able to discover accident-producing conditions with the machine in operation, but more often the major accident-producing conditions, such as cracks in reciprocating parts, are discovered with the parts dismantled. Very often the inspector's desire to dismantle certain parts is objected to by the owner or operator because of the expense incident to dismantling. What the operator overlooks is that it is not necessary to dismantle the entire unit completely at any one time. The successive inspections of the more vulnerable parts may be made at various week-end shutdown periods and the strain to which such equipment is susceptible makes this procedure highly desirable.

Because of his constant supply of information regarding accidents and operating and maintenance troubles, the insurance inspector is in a position to know which parts are most frequently sources of trouble, i.e., those parts in which cracks or other types of failure are most likely to occur. Such experiences are well illustrated by a recent case in which one of the inspectors of the Hartford Company participated.

While the inspector was making the regular examination of insured unfired pressure vessels, the chief engineer of the plant mentioned that two years previously the shaft of a large uninsured steam-type ammonia compressor had been built up by fusion welding when a new balance wheel was being installed. The inspector, knowing that the

welding of high carbon steel shafts is conducive to crack formation, offered to examine the welded shaft of this uninsured compressor and, upon subjecting it to a whitewash test, he disclosed a progressive crack adjacent to the welding. Needless to say, a new shaft was ordered immediately, since the compressor was responsible for production totaling approximately $8,000 per day.

Engineering Advances Through Inspection Experience

In steam engines having center cranks, and in diesel engines, misalignment is a frequent source of failure of the shaft itself and of its bearings. To combat this, Hartford Company engineers developed an instrument known as the "H.S.B. Strain Gage." This instrument has long been used by all its inspectors and is now used by some manufacturers' installers and other engineers to see that bearings are maintained in the degree of alignment necessary to prolong the life of the shaft.

With diesel engines the most dreaded of all accidents are those resulting from crankshaft and crank-bolt breakage and connecting-rod failures, because such failures usually result in the complete wrecking of the engine. With these accident-producing conditions, and with others not mentioned, the insurance engineer has a definite recommended schedule, based upon exact experience and statistics with a large variety of types and installations, for each plant which he visits.

In the steam turbine field it is generally recognized that, to augment operating and maintenance care by the plant's own personnel, the turbine manufacturers usually offer a service in the inspection of machines of their own make. It is not the intent of insurance inspection to supplant, but to supplement, any inspections that may be made by the manufacturer's installation engineer or service man. Here again, as with other types of objects, the experience regarding accident-producing conditions with turbines of all makes is an asset that is not held by any engineer except an insurance engineer of a company which has under its inspection many machines, of all the different makes, operating under a wide variety of load and operating conditions.

One of the important items which the insurance engineer is concerned with in his operating inspections of the turbine is vibration. This condition may be the result of cracks in blades, buckets or wheels, distorted spindles or rotors, or defective bearings, etc. For this

important feature of the inspection special vibrometers have been developed by the Hartford Company for the use of its men. The source of the majority of so-called "catastrophe" losses in connection with turbines has been the explosion of casings due to inoperation of atmospheric relief valves, etc. and the failure of wheels.

During the eighteen years that electrical machinery insurance has been available, much valuable experience has been gained by insurance engineers to enable them to eliminate guesswork in determining whether the physical condition of such apparatus is below standard and in making the proper recommendations for repair or replacement. Insurance statistics show definitely that windings account for the majority of accidents, both in frequency and amount; therefore, their condition is of utmost importance. While insulation resistance measurements have their place and are made by all insurance engineers, to be useful they must be intelligently interpreted in the light of the general condition of the insulation. In this connection it may be interesting that during a period of only one year, the engineers of the Hartford Company prevailed upon insured owners and operators to remove from service 19 turbo-generator fields ranging in size from 1,000 to 30,000 kw., due to dangerous conditions brought to light during inspection. It was necessary to rewind all of these rotors. There is no question, however, that the cost of the rewind was only a small fraction of the possible cost of repair and of the loss the plants would have suffered from service disruption had the machines been run to the point of failure.

Design, Construction and Installation Activities

In this discussion of the protection of power equipment one phase—design, construction and installation—participated in by insurance engineers, has not been mentioned. Long before the inception of the Boiler Code of the American Society of Mechanical Engineers, now the universally recognized code for the design, construction and installation of boilers and unfired pressure vessels, insurance engineers were instrumental in setting up safe practices along this line and in providing the necessary shop inspection during construction to assure safe structures. They not only participated in the compilation of the first edition of the A.S.M.E. Code, but have continued to contribute information toward keeping it up to date with modern practices, particularly as applied to the use of fusion welding and the construction of boilers and vessels for high pressures and tempera-

tures. Incidentally, approximately 95 per cent of the designs for new boilers and pressure vessels, built and stamped today in accordance with A.S.M.E. Code, are reviewed and the vessels themselves shop-inspected during construction by insurance engineers.

Insurance engineers have not played so direct a part in the design and construction of machinery, but the engineers, serving on various engineering committees, have indirectly contributed to improvements along these lines. From experience gained in recent years through accidents and conditions discovered during inspection, they have made many contributions directly to manufacturers of steam engines, diesel engines, pumps, compressors, steam turbines and electrical machinery. Often their recommendations have enabled the manufacturer to improve the design and add to the life of his equipment. To an even greater extent, insurance engineers have contributed their experiences to promoting correct installations, especially as applied to proper protective devices, and this service is an asset that is always available to the owner or operator of insured equipment.

Billing Procedure for a Group of Small Plants

By William H. Ogden

THE water supply properties involved in this discussion are those of the New York Water Service Corp. and its subsidiary, the South Bay Consolidated Water Co., Inc., in Nassau and Suffolk Counties on Long Island. In all there are fourteen water plants, but four are not of sufficient size to justify the maintenance of local offices; consequently, billing and other office work is divided among ten offices in the territory. Each of these offices is in charge of a local superintendent who supervises the office work and the meter reading, collecting, service and meter installations and repairs.

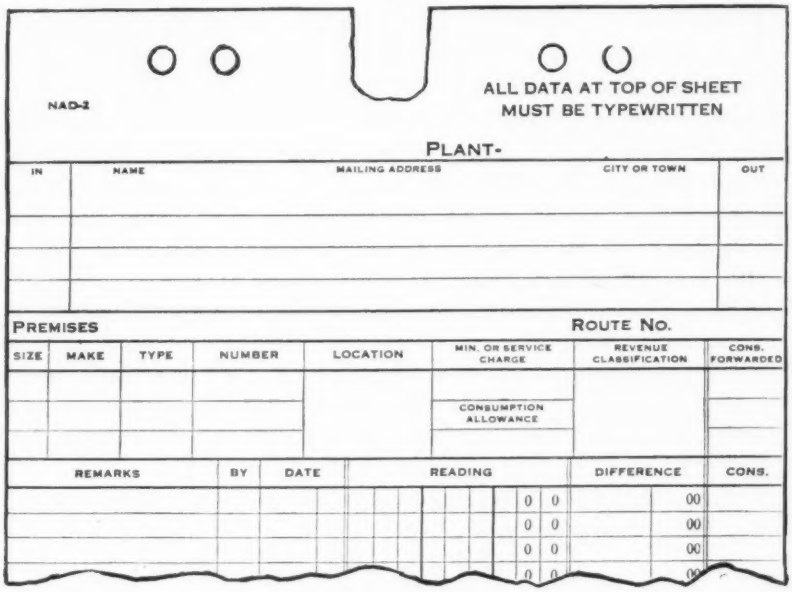
The combined properties provide service to approximately 30,000 customers in about 50 communities comprising an estimated population of 125,000. The number of accounts handled by each of the ten local offices varies from 925 to 5,100, with an average of approximately 3,000 accounts per office. In the smallest office all of the billing and clerical work is handled by the superintendent and one clerk, while the largest office is maintained by a superintendent and three clerks. The total clerical force, exclusive of the superintendents, for the entire group of properties comprises eighteen employees, an average of approximately 1,650 accounts per employee.

Meter reading is handled by regular employees assigned to the local offices. In the case of the smaller offices, where meter reading does not require the full time of one employee, other duties are assigned. In the case of the two largest offices the meter reading program requires practically the full time of one employee at each office. The meters are read and bills are rendered quarterly to all customers except large commercial accounts, which are billed monthly. Although the billing is on a quarterly basis, the accounts handled by

A paper presented on September 12, 1941, at the New York Section Meeting, Glens Falls, N. Y., by William H. Ogden, Vice-President, New York Water Service Corp., Glen Cove, N. Y.

each office are divided into three districts, with billing dates adjusted so that one district, or approximately one-third of the accounts, is billed each month during the year. The advantage of this procedure is evident in that it results in a continuous billing process without accumulation of any large volume of clerical work at one time.

The basic record of each customer's account is maintained on a meter sheet, 6 x 9 in. in size (Fig. 1). This sheet carries the name, mailing address, the address of the premises served, the company's reference number to the account, the size, make and serial number of


NAD-2

ALL DATA AT TOP OF SHEET MUST BE TYPEWRITTEN

PLANT-

IN	NAME	MAILING ADDRESS	CITY OR TOWN	OUT

PREMISES ROUTE NO.

SIZE	MAKE	TYPE	NUMBER	LOCATION	MIN. OR SERVICE CHARGE	REVENUE CLASSIFICATION	CONS. FORWARDED
					CONSUMPTION ALLOWANCE		

REMARKS	BY	DATE	READING	DIFFERENCE	CONS.
			0 0	00	
			0 0	00	
			0 0	00	
			0 0	00	

FIGURE 1

the meter in service, a sketch showing the location of the meter in reference to the property line or building, and the minimum charge applicable under the appropriate rate schedule for each customer served. All of this information is shown at the top of the sheet and is maintained as a permanent record of the account. Provision is made for recording changes in customer's name or address and likewise for changes of the meter in service at the property. In the body of the meter sheet, provision is made for the individual readings of the meter and for each reading, space is provided for the meter reader's initials, the date and the difference between the current and

previous readings. All of these data are noted in the field by the meter reader.

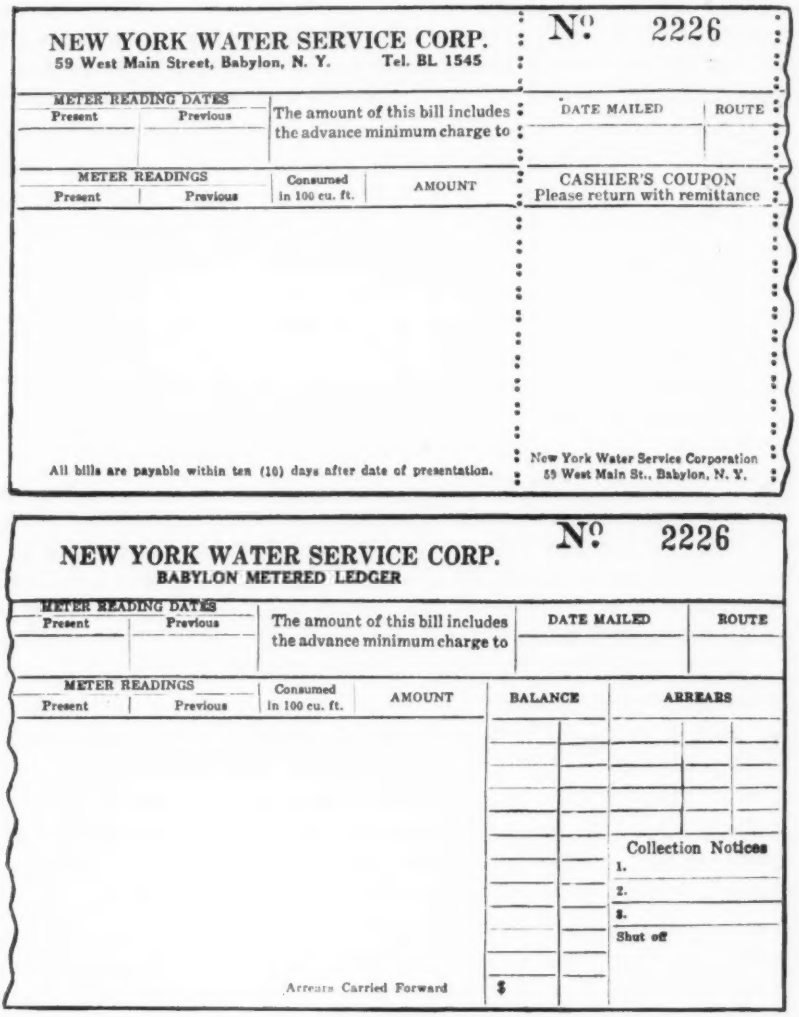
Meter sheets are bound in books varying in size from 60 to 125 sheets, depending upon the type of territory, each book being designed as approximately one day's work for the meter reader. By varying the number of accounts contained in the meter books, an attempt is made to compensate for the additional time required in reading meters in sparsely settled sections as compared with the time required in closely built-up urban sections. The average for all meter reading is approximately 90 accounts per man-day. In this connection it is interesting to note a paper by Kenneth K. King* in which it is indicated that in some of the Southern cities meter readers average nearly 400 readings per day, but that for 25 cities listed in the northern section of the country the average was slightly under 100 readings per working day.

On completion of the reading of each individual meter book by the meter reader, the book is submitted to the local superintendent for review and check. On each individual sheet the superintendent repeats the subtraction of the previous from the current reading in order to check the accuracy of the computed water consumption for the bill. The local superintendent then inserts in the space provided opposite the meter reading the final computation of the consumption. When this has been completed for each account in the book, the entire group of accounts is ready for billing.

The stub form of customers' bill and ledger (Fig. 2) was adopted in 1931, prior to which date individual ledger sheets were maintained for each account. The use of the stub billing system eliminates maintenance of the customers' ledger sheets, together with considerable clerical work. The bill form consists of three parts: (1) the customer's bill; (2) the cashier's coupon; and (3) the company's ledger stub. On the customer's bill are shown the present and previous meter readings, the consumption for the period, the amount billed, and the dates of the present and previous readings. On the cashier's coupon is shown the number of the bill, the date the bill was mailed and the amount billed. The company's ledger stub provides space for the same information as that contained on the customer's bill and, in addition, provision is made for inserting the date the bill is

*KING, KENNETH, K. Meter Reading and Commercial Department Operation. Jour. A. W. W. A., **33**: 1373 (1941).

mailed and for a detailed analysis of any arrears which may be due for service previously rendered. In addition, each of the ledger stubs is numbered to provide a cross-index to the corresponding number



NEW YORK WATER SERVICE CORP.
59 West Main Street, Babylon, N. Y. Tel. BL 1545

No. 2226

METER READING DATES
Present | Previous

The amount of this bill includes the advance minimum charge to

DATE MAILED | ROUTE

METER READINGS
Present | Previous

Consumed in 100 cu. ft. | AMOUNT

CASHIER'S COUPON
Please return with remittance

All bills are payable within ten (10) days after date of presentation.

New York Water Service Corporation
59 West Main St., Babylon, N. Y.

NEW YORK WATER SERVICE CORP.
BABYLON METERED LEDGER

No. 2226

METER READING DATES
Present | Previous

The amount of this bill includes the advance minimum charge to

DATE MAILED | ROUTE

METER READINGS
Present | Previous

Consumed in 100 cu. ft. | AMOUNT

BALANCE | ARREARS

Collection Notices
1.
2.
3.
Shut off

Arrears Carried Forward $

FIGURE 2

printed on the cashier's coupon. The amount billed is determined by the billing clerk by reference to a chart showing proper billing amount for all varying water consumptions. Bills are printed as one complete

form with perforations between the sections to permit ready separation of the ledger stubs when the billing is completed.

The customer's bill, with cashier's coupon attached, is the same size as the standard Government postcard, measuring $5\frac{1}{2}$ x $3\frac{1}{2}$ in. The customer's name, mailing address and account number are printed on the reverse side of this bill and ledger card by a standard addressograph plate. This work is done at a central addressograph bureau which is at the service of all ten local offices. The centralization of the addressographing was found to be economical, as it eliminated the necessity of furnishing addressograph equipment for each of the local offices and further permitted the handling of the work by a single trained operator. The addressographing is done prior to the billing and the plates are arranged in the same order as the meter sheets so that the blank bills furnished to the billing clerk are already fully addressed and need to be completed only for the actual billing data.

All dates shown on the customer's bill, the cashier's coupon and the ledger stub are arranged in one horizontal line across the bill form. This permits inserting all of these dates on the three forms in one operation by use of a multiple bank of band daters. Likewise, all data on the three sections of the bill involving meter readings, consumption, and amounts billed are arranged in a single horizontal line. This permits insertion of these data by typewriter without moving the bill in the machine once it is placed in position. The practice of rendering bills in typewritten form has resulted in notable improvement in the appearance of the bills and favorable comments from customers have been received as to clarity of the record.

On completion of the preparation of the bill forms, the totals of the present readings, previous readings and the consumptions are obtained by adding machine. This is done as a further check on the accuracy of the subtraction of the readings and also to eliminate any possible errors in the transcription of the data to the billing form. Obviously, if the computations are correct, the total of the water consumptions billed in the entire book will equal the difference between the total of the present readings and the total of the previous readings.

On completion of the billing, the ledger stubs are separated from the bills and filed as the company's record of the billing and the amounts receivable. The customers' bills with cashier's coupons attached are mailed as post cards without envelopes. Postal regula-

tions permit issuance of invoices on post cards but prohibit the use of post cards for collection of past due accounts. This regulation is interpreted to mean that bills carrying arrears balances cannot be issued in post card form, and for these accounts window envelopes are provided which permit the use of the standard bill with the addressographed address appearing in the window section of the envelope. The individual rate schedules applicable in the various territories served by the local offices are printed on the reverse of the cashier's coupon.

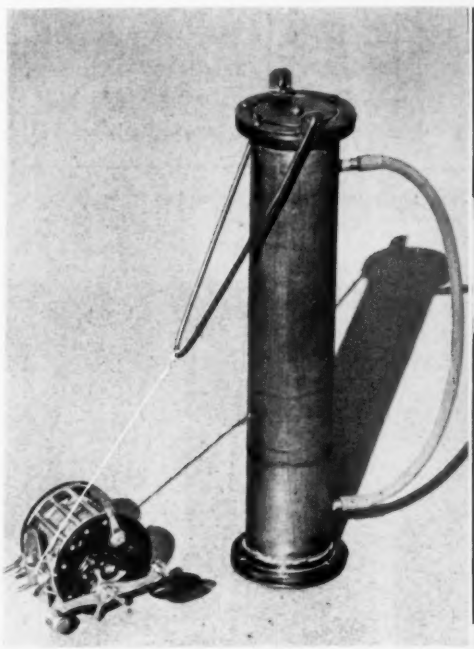
Some slight saving in clerical expense could undoubtedly be effected if the billing for all of the ten local offices could be handled at one central point with machine billing equipment. This procedure would, however, involve sending the meter books away from the local office for a period of a week or ten days during the billing period. The absence of these fundamental records from the local office makes it difficult if not impossible to handle adequately customers' inquiries, so, after some study and trial, it was determined that the continual availability of these records justified the additional costs involved.

A further advantage in the handling of the billing in the local office is the reduction in time required from the date of the meter reading to the date on which the customer's bill is issued. During the trial of the central billing plan it was found that the elapsed time from the reading date to the mailing of the bill ranged from 10 to 16 days. This delay was necessary partly because of the time required for the reading of the entire month's billing district and partly because of the time required for transferring the meter book records to and from the central billing office. Under the present procedure, where billing is handled in the local office, bills for each meter book are prepared and mailed as quickly as possible after the reading of the individual route. The average time required for issuance of the bill after the meter reading has been reduced from 13 days to 4 days, and this has resulted in a corresponding acceleration of collections.

In the development of the billing procedure used by the companies every effort has been made to furnish the customer with a complete record of water consumption and money due, in a form which is fully understandable by those who are not ordinarily familiar with meters and utility rate schedules. It is believed that the present forms largely accomplish this purpose and that generally improved public relations have resulted.

Depth Sampler

DESIGNED on the principle of the sand pump, the device shown in the accompanying illustrations serves effectively for the collection of water samples at any desired depth in streams or reservoirs. The apparatus, as developed by A. Munro and S. M. Bennett of the Los Angeles Bureau of Water Works and Supply,



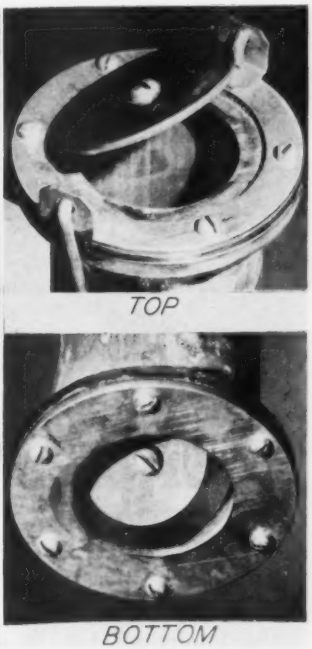


FIG. 1 FIG. 2

FIG. 1. Depth Sampler
FIG. 2. Close-up of Upper and Lower Flap Valves in the Open Position

A contribution of the Sanitary Engineering Div., Bureau of Water Works & Supply, Los Angeles.

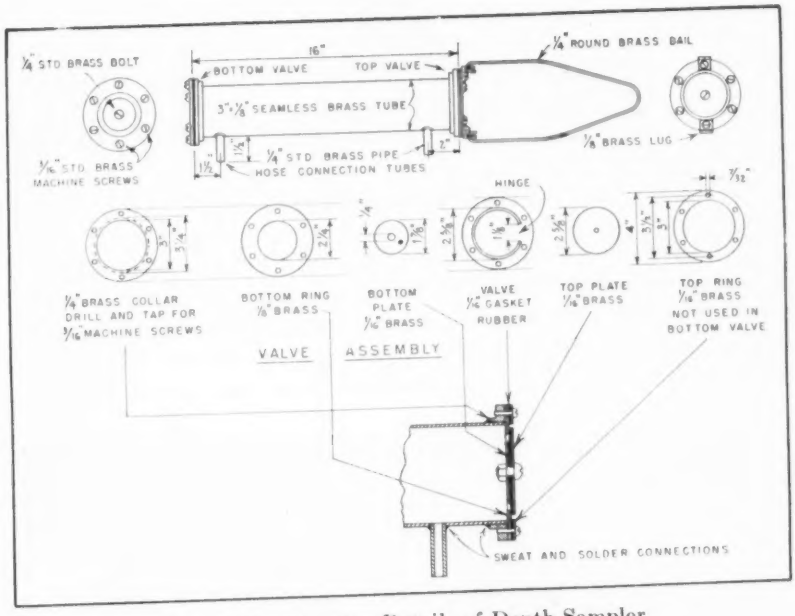


FIG. 3. Construction Details of Depth Sampler

FIG. 4. Preparing to Draw Aliquots

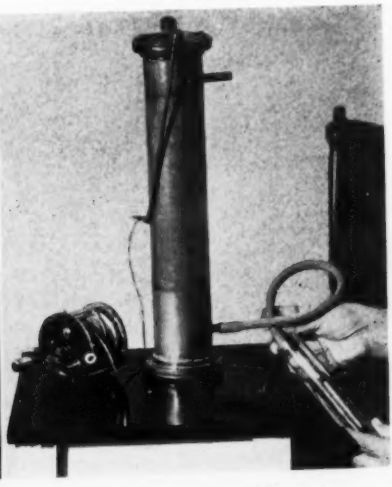


FIG. 5. Drawing Aliquot

has been in constant use during the past seven years for the regular collection of depth samples in the Los Angeles water system. The simplicity of design and operation of this depth sampler insures trouble-free performance under all conditions.

In operation, the two flap valves (Fig. 2) are held open automatically by the water rushing through the sampler as it is lowered to the desired level. At this point, the sampler is made to act as a pump by plunging it slowly up and down through a distance approximately equal to the sampler's height. This forces sufficient water through the sampler to assure the trapping of a representative sample at the desired depth. The sampler is then lifted with a steady upward pull so as to prevent the functioning of the flap valves. The aliquot portions for the different physical and chemical determinations are obtained by pulling the rubber tubing away from the upper nipple (Fig. 4) and using this tubing as a guide for directing the water into bottles or volumetric measuring devices (Fig. 5).

One sampler full contains sufficient water for the performance of all the field determinations ordinarily made in natural water.

Comments on Committee Report on Methods of Determining Fluorides

By Elias Elvove and R. F. Goudey

Elias Elvove.* The report states (p. 2008, November JOURNAL): "It will be noted that a total of 330, or 52 per cent, of the 638 values were obtained by means of the original Sanchis method or by one or the other of the two modifications employed. It is immediately evident that since the mean value for each individual sample has been obtained by averaging all acceptable values, it has been weighed more by values obtained by these methods than by those of any other method. The question of the fairness of comparing the results of individual methods using a mean value so obtained as a criterion immediately presents itself and must be given consideration."

The answer to this criticism, however, apparently does not meet the point raised. Reference is made to Table 6 and it is stated that the data of this table make apparent the rather remarkable "uniformity" which exists with respect to the means of values obtained by the individual methods. Reference is also made to Tables 14 and 15 and it is pointed out that there, too, "uniformity" is evident. If we agree that these tables show that the results by all of the methods were uniform, however, it is difficult to see how we

Comments concerning the report of the Committee on "Methods of Determining Fluorides" reached the Editor too late to be included in the November issue of the JOURNAL in which the report was published. The statements are presented herewith, without comment, in order that the current volume of the JOURNAL may contain both the report and the dissenting opinions. The Water Purification Division of the A.W.W.A. as well as the Joint Editorial Committee (A.W.W.A.—A.P.H.A.), for the text of *Standard Methods for the Examination of Water and Sewage*, will be able, with the information now available, to outline a method of determining fluorides satisfactory for waters within the ranges of mineralization recorded by the U. S. Public Health Standard as suitable for drinking water.

* National Institute of Health, U. S. Public Health Service, Bethesda, Md.

can later conclude that they differ and brand some as "poorest." Furthermore, since the values of the means taken as standards of reference were not determined independently of the methods the accuracy of which we are questioning, what proof is there that the results by the method given the least representation in the 638 values are not in reality nearest to the true values?

Let us take, for example, the first sample (No. 1) listed in Table 6. We want to know the true fluoride content of that water. According to the report, Laboratory A, using the Sanchis A method, found 6.5 p.p.m.; Laboratory G, using the same method, found 7.0 p.p.m. It is admitted that if we also include the results of Laboratories B, C, D, I, and J and average all seven results, we would obtain a mean close to 6.5, which is also the value of the mean taken as the standard of reference. In practice, however, the sample probably would not be examined by more than one or two laboratories. If the two laboratories should happen to be A and G, one would report 6.5 and the other 7.0 p.p.m.

On the other hand, according to the report, the same sample examined by Laboratory C, using the modified Elvove method, showed 6.4 p.p.m.; Laboratory D, using the same method, found 6.5 p.p.m. With this method both laboratories obtained reasonably concordant results, which were also close to the value of the mean taken as the standard of reference. In other words, in this case, only two results were used to obtain a mean close to the standard mean, as against seven results by the Sanchis method. By using disproportionately large numbers of results by one method as against a comparatively small number by the other method in this way we might be led to conclude that what is in fact a more reliable method shows the "poorest distribution."

Results given in the report that are germane to the point concerning the effect of comparatively large concentrations of sulfate may be presented as shown in Table 1 of this discussion.

These results point to the same general trend concerning the effect of sulfate as results reported by Scott and co-workers (Jour. A. W. W. A., **29:** 9 (1937)). Using the Sanchis method, they found that corrections are required for sulfate. Their given corrections were of the order of 0.1 and 0.15 p.p.m. for waters containing 400 and 500 p.p.m. of sulfate, respectively.

It appears, however, that the effect of the sulfate on the fluoride reagent is also dependent to some extent on the fluoride concentra-

tion. Table 2 of this discussion is quoted from a paper by Walker and Finlay (Canadian Journal of Research, **18**: Sec. B: 151 (1940)).

TABLE 1

Comparison of Results by Sanchis and Elvove Methods; when applied by same laboratories to waters containing about 600 p.p.m. or over of sulfate—values in parts per million

LOCALITY	SULFATE CONTENT	LAB.	DIRECT SANCHIS				ELVOVE			EXCESS DIFFERENCE BY SANCHIS METHOD	FADING OF COLOR READ AS FLUORIDE BY SANCHIS METHOD BUT POSSIBLY DUE TO SULFATE
			A	B	D		Orig.	Mod.			
Grafton, N. D.	605	E	4.1	3.7			3.7	3.4			
Higher value						4.1			3.7		
Lower value						3.7			3.4		
Difference						0.4			0.3	0.1	
Mean						3.90			3.55		0.35
Grimes, Iowa	618	A	6.5	6.3	6.5		5.8				
		D	6.3	6.2	6.3		6.0	6.0			
		E	6.9	6.4			6.2	5.9			
Highest value						6.9			6.2		
Lowest value						6.2			5.8		
Difference						0.7			0.4	0.3	
Mean						6.42			5.98		0.44
Plankington, S. D.	838	C	1.8	1.7	1.7			1.6			
		E	1.8	1.7			1.6	1.5			
Higher value						1.8			1.6		
Lower value						1.7			1.5		
Difference						0.1			0.1	0.0	
Mean						1.74			1.56		0.18
Britton, S. D.	1130	C	7.8	7.3	7.5		6.7	6.5			
		D	7.0	7.0	7.0		7.0	6.9			
		E	7.3	7.1			6.7	6.6			
Highest value						7.8			7.0		
Lowest value						7.0			6.5		
Difference						0.8			0.5	0.3	
Mean						7.25			6.73		0.52
Mean										0.17	

They followed the Sanchis procedure of introducing 2 ml. of 3 *N* sulfuric acid, "so that the effect of varying amounts of sulfates in natural waters met with in ordinary cases will be minimized."

It is thus seen that, by the Sanchis method, Walker and Finlay found 0.1, 0.2 and 0.6 p.p.m. fluoride in waters that were known to be entirely free from fluoride, but containing 300, 480 and 1,200 p.p.m. of sulfate, respectively. A water known to contain 0.4 p.p.m. fluoride and 1,800 p.p.m. sulfate showed up as containing 1.1 p.p.m. fluoride, i.e., close to three times its true fluoride content. A water known to contain 0.6 p.p.m. fluoride and 600 p.p.m. sulfate showed up as containing 0.9 p.p.m. fluoride; and in the presence of 1,200 p.p.m. sulfate, the 0.6 fluoride showed up as 1.1 p.p.m. fluoride, i.e., almost twice what it was known to contain.

TABLE 2

Influence of Sulfates on the Determination of Fluorine—F^- shown in parts per million

F^- PRESENT	SULFATES ADDED, SO_4, P.P.M.							
	120	300	480	600	1200	1800	2400	3600
0.0	0.0	0.1	0.2	0.2	0.6	0.7	0.9	1.1+
0.2	0.3	0.3	0.4	0.4	0.7	0.8	1.1	
0.4	0.4	0.5	0.6	0.7	0.8	1.1	1.2	
0.6	0.6	0.7	0.8	0.9	1.1	1.3	1.5	
0.8	0.8	0.9	1.0+	1.1	1.2	1.5		
1.0	1.0	1.0+		1.2	1.4			
1.2	1.2	1.5						

R. F. Goudey.* Without detracting from the excellent report prepared under the direction of Chairman A. P. Black, the writer would like to point out that further consideration should be given to the effect of interfering substances, at least for abnormal waters, and that there needs to be a clear recommendation on what *Standard Methods* should include on the fluoride test. The Bureau of Water Works and Supply laboratory has standardized on the Scott modification of the Sanchis method, now called the Scott-Sanchis method, as being the quickest, simplest, and most reliable test for normal potable waters, where interfering substances are of too low a concentration to affect results.

* Sanitary Engineer, Department of Water and Power, Los Angeles.

It is noted in the Committee Report that, throughout the investigation, which included a number of abnormal waters, the precision was found mathematically to be of the same general order of magnitude and that it *appeared* that this precision was independent of the concentration of total dissolved solids, of the fluoride ion, or of any other ion present in the samples tested. It is hoped that this paragraph will not mislead the reader to conclude that the method is specific or all-inclusive.

The interference of various ions has long been recognized. Elvove (1, 2) goes so far as to require a chemical analysis of samples being tested for fluoride in order to prepare synthetic compensating standards. Considerable work was done in regard to sulfate interference on the original Sanchis method (3), indicating that sulfates interfere above 500 p.p.m. Referring to the same method, Scott and his associates (4) found that at a concentration of 400 p.p.m. a correction of 0.1 p.p.m. should be applied. Walker and Finlay (5) found 0.1, 0.2, and 0.6 p.p.m. of fluoride in waters which actually contained no fluoride but 300, 480, and 1,200 p.p.m. of sulfate respectively.

Inasmuch as the Scott method is fundamentally the Sanchis method, the question of interfering substances remains unanswered. There should be some explanation in *Standard Methods* about interfering substances when the Scott-Sanchis method is used for abnormal waters. Such a statement should be based on further investigation, giving special consideration to silicon, aluminum, iron, phosphate, sulfide and sulfate ions. For all waters suspected of having interfering substances or which constitute abnormal or highly mineralized waters, the distillation procedure should precede the Scott-Sanchis method.

References

1. *Standard Methods for the Examination of Water and Sewage.* Am. Public Health Assn. and Am. Water Works Assn., New York (8th ed., 1936), p. 36.
2. Elvove, E. Estimation of Fluorides in Waters. Pub. Health Repts., **48:** 1219 (1933).
3. Sanchis, J. M. Determination of Fluorides in Natural Waters. Ind. Eng. Chem.—Anal. Ed., **6:** 134 (1934).
4. Scott, R. D., Kimberly, A. E., Van Horn, A. L., Ey, L. F. and Waring, F. H. Fluoride in Ohio Water Supplies—Its Effect, Occurrence and Reduction. Jour. A.W.W.A., **29:** 9 (1937).
5. Walker and Finlay. Canadian Jour. Research, **18:** Sec. B: 151 (1940).

Revising the U. S. Standards for Drinking Water Quality

Discussions by Abel Wolman, J. K. Hoskins, A. M. Buswell, A. A. Hirsch, L. C. Billings, E. Sherman Chase, and Ralph E. Noble

Abel Wolman.* Historically, a discussion of the underlying philosophy of water quality standards—if there be any such philosophy—is particularly interesting because about sixteen years ago, when the 1925 standards were under discussion by the Association, the same problems and the same ramifications applied. Unfortunately, however, it is not possible to achieve a simple quantitative index of water quality. The 1925 standard was, and any subsequent one arrived at in 1941 or at any future date must be, an empirical one. This is true because the water works field unfortunately is one in which empiricism is the only method by which a standard of bacteriological density, or chemical character, or physical quality, or of any of the attributes discussed, can easily be arrived at.

The water works field is one in which the complex to be defined is difficult to evaluate by a simple single index—how difficult can be sensed from the fact that the present discussion is but a continuation of a half-century's efforts to arrive at an index that can be applied by anyone. Such an index, though highly desirable, does not exist and probably never will. Indeed, little hope can be held out for any single simple expression that will fulfill all of the necessary requirements of a water quality standard, i.e., (1) universal applicability, (2) the necessity for the preservation of a wide area of consumer protection, (3) ease of application, and (4) specificity.

A group of discussions, the first three of which are abstracted from the stenotypist's record of the discussion following the presentation of the symposium on the proposed revision of the Treasury Standard at the Toronto Convention (p. 1804, October JOURNAL); and others submitted in response to the invitation which accompanied publication of the symposium.

* Professor of Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

The elements, historically, that today must be considered in relation to redefining a standard, if it must be defined, should be pointed out. First it must be clear to whom the standard is to apply—interstate carriers, any other specific group, or suppliers in general. Then, the function of the water to which it is to apply—potable, industrial, irrigation—must be stated clearly in the standard. There is a multiple aspect of both area and use which is of primary concern in the consideration of any new Federal standard.

Application of Standard

In answer to the first question it may be assumed that any new standard adopted will not, as have previous ones, be masked as an enterprise for public health service applicable only to railroad carriers, steamships, etc., but, rather, will receive universal application in the judging of the quality of water supplies in this country. Also, the use to which water is put will affect materially the characteristics of the standard.

Another phase is the economic one. Baylis has pointed out a very significant fact—that there are dollar values attached to the kind of performance demanded by such a standard. The writer must, however, differ with him concerning the dollar values which would be returned if the level of bacterial demand were raised to the extent advocated by Baylis.

The "freezing" of design procedure by setting up production standards, as advocated by Baylis, and the intrusion of the revised standard into the method of production and operation, as tentatively suggested by Hoskins, would certainly be objectionable changes. In the public health field today the great emphasis placed on the grading of milk twenty years ago is regretted. The question of who is to drink Grade B water may well be raised here. The same question was asked in establishing the grading schedule for milk and answered by the statement that, since the commodity was needed so badly in a great many areas, the only way to satisfy that need was to permit inferior quality milk to be served to people who could not afford to pay for the better grade product. It would be very sad indeed to see this philosophy enter the water supply field. Everyone should be in a position to obtain good water from a public supply.

One additional element to be considered with respect to any standard is that bacteriologically, at least, the only way to apply any

criterion with a coliform group—fecal or non-fecal—is in the form of circumstantial evidence. That is all it has ever been; and, as long as the use of this type of index is continued, criteria will be in the realm of circumstantial evidence, supplemented, however, by all other phases of water supply treatment control.

Size of Test Portions

It has been intimated that 100-ml. rather than 10-ml. portions are to be used in the actual test procedure—a change that, as every speaker has pointed out, will, regardless of its merit, involve a change in sampling procedure, in sampling equipment, in laboratory equipment and in general over-all costs. The natural question which should be raised is whether the increase or improvement in statistical accuracy, for which there is an obvious mathematical basis, is worth the change from orthodox technique. Is it worth changing a familiar method to get an increased degree of accuracy in the range of about one coliform organism or less per 100 ml.? The writer must confess that he cannot get overly excited about it, largely because in thinking to scale, he is not convinced that the modification in the volume of the sample, which in itself is such an infinitesimal fraction of the volume of the material being produced, is essential to the control technique or would give returns which are commensurate with the tangible and intangible costs of the suggested change.

This refinement in technique to obtain a more accurate indication of coliform density introduces into the standard something not originally present. The 1925 standard was carefully and deliberately written with five 10-ml. portions in mind rather than any definite "most probable number." While this is no reason for not increasing the size of the test portions to 100 ml., the reason for making such a change should be understood and not tied to an apparent intention not present in the design of the original standard.

In summary, therefore, all that is emphasized here is that water quality is a complex of many attributes of natural and artificial origin. The effort to evaluate such attributes by any easy slide-rule measure of simple indices is impossible and unwise to attempt. Water quality determination is a composite of many diagnostic measures and the protection of the consumer requires a broad evaluation of origin, treatment and product rather than an overemphasis on the minutiae of coliform density, involving a choice between 1 and 0.5 coliform organism per 100 ml. The great danger of the latter

concept lies in the undue faith in such a measure which gradually turns the operator increasingly away from *all* other factors of quality to only one elusive one. In this field, as in so many others, the handbook of design, of operation and of product cannot be substituted for the use of the head.

J. K. Hoskins.* Upon review of the proposed change in size of the fermentation test portion from 10 to 100 ml., the conclusion has been reached that it is physically and mathematically not practicable to determine whether a sample does or does not contain one coliform

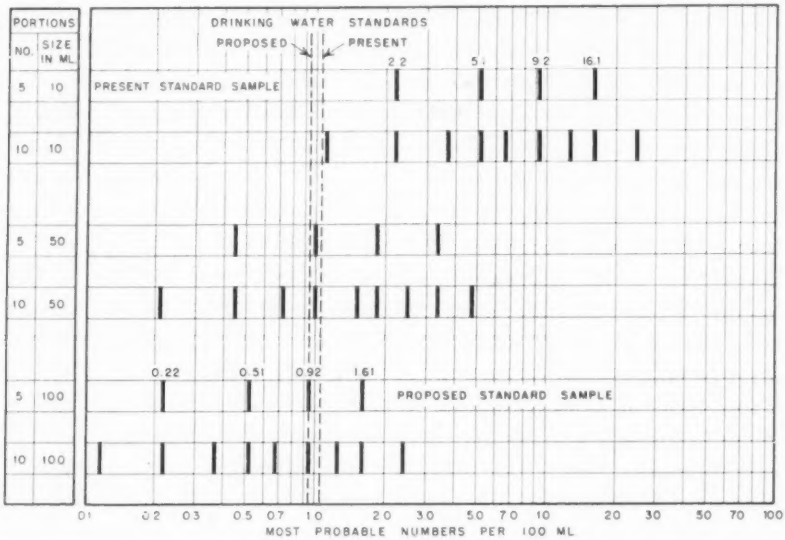


FIG. 1. Plot of M.P.N. Values for Different Sizes and Numbers of Portions in Samples

organism per 100 ml. when 10-ml. portions are used. It is a fact that by examining five 10-ml. portions of the sample the minimum most probable number that can be determined by that procedure is "two"; and the only possible way to achieve a determination of "one" is to examine a larger quantity of water.

The entire matter may be clarified by reference to Fig. 1. Solid bars on the various horizontal lines of this figure indicate the possible results that may be obtained when various numbers and sizes of

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portions of samples are employed. The horizontal logarithmic scale permits plotting of the most probable number values per 100 ml. of the samples. Thus, when five 10-ml. portions are examined, the result may be 2.2, 5.1, 9.2 or 16.1 coliform organisms per 100 ml., depending upon whether one, two, three or four of the five portions give a positive result.

If the five portions are increased to ten, nine positive results are possible, the lowest of which is the limiting standard; but if it is desired to know when the sample is approaching the limiting standard, the only way that that can be determined without unreasonably increasing the number of 10-ml. portions is to increase the size of the separate portions. If, for example, five 100-ml. portions are examined, it is possible to obtain one of four different results—0.22, 0.51, 0.92 or 1.6 organisms per 100 ml.—depending upon whether one, two, three or four portions are positive.

In other words, this procedure affords a determination on the lower side of the standard rather than above it. Thus, if five 100-ml. portions are examined and two are positive, a definite indication that the standard is being approached is obtained, and such a definite indication is obtained from one water sample. If five 10-ml. portions per day are examined, such information cannot be obtained until one positive tube is obtained; and, in such a case, the standard has been exceeded before the operator knows what has happened.

The question of whether or not a single daily sample is sufficient to present a picture of the day's operation of the purification plant brings up a very practical point in plant operation. The writer seriously doubts whether it is safe for any plant of any size at all to examine but one sample a day, or to assume that one sample a day is representative of the output of a plant of any capacity.

A. M. Buswell.* The examination of five 100-ml. portions presents a real practical problem, particularly at the present time with priorities and various other complications in getting material and supplies. Some large laboratories, with their incubator space already overloaded, will also find it difficult to expand sufficiently to accommodate the added volumes required in the proposed standard.

Since it is a preliminary report which is being discussed, the writer would like to suggest some further consideration of the "caustic

* Chief, State Water Survey Division, Urbana, Ill.

alkalinity" limit. In the light of newer calculations to which some attention is being given in the Illinois water survey laboratory, it is believed that the results intended can be accomplished more satisfactorily by using a sliding scale for the caustic alkalinity with respect to the total alkalinity. Using the scale, the caustic alkalinity may be allowed to reach about 35 p.p.m. for a total alkalinity of 50 p.p.m. This limit would decrease as the total alkalinity increased.

A. A. Hirsch.* The titular connotation of the present Treasury Standard implies some attainment of excellence by the qualifying supplies, despite the disavowal of guaranteed safety by the Surgeon General's Advisory Committee of 1922. As clearly conceded in previous printed discussions, however, the bacterial quality of treated supplies, particularly the larger ones, has far surpassed the Federal specifications without serious difficulty in plant treatment. These improved results, beyond the requirements of the existing standard, have been due to improvements in the art, to the desire for higher factors of safety and to the zealous striving of most operators toward higher goals. At any rate, it seems fairly well agreed that the present bacterial limits do not reflect the superior results widely attained in practice. Hence, if the current coliform limits are still retained, admittedly the term "Standard" is a patent misnomer and should be replaced by a more accurately descriptive designation such as "Minimum Requirements for Acceptable Potable Water Served in Interstate Commerce."

Application to Interstate Highway Facilities

Attention may also be directed to the import of the term "interstate commerce" in the light of modern travel habits. Watering facilities at airports and on planes should require certification; bus station water supplies, also, should require formal approval from certifying officers. Yet all means of public utility passenger accommodations taken together are only a small fraction of the interstate travel done in private automobiles—the very field in which administrative control of drinking and culinary water quality is especially weak. In a broad sense the U. S. highway system is an indispensable interstate commerce facility, though not actually a

* Sectional School on Water Supply and Sewerage, State Department of Education, Baton Rouge, La.

vehicle, and municipalities lying on Federal routes should come directly under the purview of these standards. Likewise, roadside restaurants, situated on U. S. highways, may be considered to serve interstate travelers, in effect the same as a pullman diner, and hence subject also to the Federal requirements.

A biting extension of this thought would be a co-operative agreement with the Bureau of Public Roads that Federal grants-in-aid for highways shall be denied unless the municipalities through which a road project is to pass shall be certified. A similar control over water supplies on existing U. S. roads could be exercised by requiring that annual Federal maintenance contributions be contingent on certification of public supplies along the route. A somewhat analogous supervision is at present maintained by W. P. A. authorities in requiring the approval of state health officers before accepting a sanitary improvement project; therefore it would be expected that liaison with the Bureau of Public Roads should present no serious difficulties. Roadside placards attesting to water quality approval by the State Board of Health at points on U. S. highways should be subject to the same standards as required of watering stations along railroads. These complexities in modern living should demand a set of "minimum requirements" of more general coverage.

L. C. Billings.* In order that water producers may have a uniform and adequate specification for finished water furnished to the public, it would seem perfectly logical that Federal authority should be considered proper to establish it. For many years drinking water standards of the U. S. Public Health Service have served a useful purpose to the water works profession. In the absence of other authority these standards, originally intended to apply to waters supplied interstate carriers, have been accepted insofar as they could apply to the definition of a safe water delivered by a water works system.

The 1925 Treasury Standard was an expansion and revision of that adopted in 1914. There are certain provisions in this last set of adopted standards needing revision if they are to apply directly to the definition of water produced by present day practices. Water works men and public health workers should co-operate with the U. S. Public Health Service in every way possible to formulate a

* Superintendent of Water Purification, Dallas, Tex.

working standard which can be practical and useful to water works men as a final authority.

Such a standard should be confined exclusively to the quality of the product produced by the water works, leaving methods and control systems to local and state regulation. This would include distribution requirements referring to such items as cross-connections, main sizes, etc. Local conditions often influence ways and means necessary to produce a satisfactory water.

Considerations in the Revision

In reference to the provisions to be contained in these standards one may consider the suggestion that the presumptive test in lactose broth be a basis for bacterial standard very unwise. There is no supporting evidence to indicate that water-borne disease epidemics have occurred where unconfirmed positive presumptive tests have been in the record. Many plants can show records indicating positive presumptives unconfirmed at certain times every year for 25 or more years and that no epidemics of intestinal disease have been noted.

By way of correction, the word causticity or caustic should be eliminated from the nomenclature of the standard. Caustic according to dictionary definition means "capable of destroying or eating away by chemical action." Certainly no water condition could approach this. Calcium hydrate is always used as a main softening agent. Even a saturated solution of calcium hydrate, however, would not destroy the delicate membranes of the digestive system or actively corrode surfaces of metals; nor has it ever been practical to use sodium hydrate to the extent that the water resulting could be aggressive in such a manner. The term to be used to represent the intended condition should be "hydrate alkalinity."

The presence of 15 or 20 p.p.m. hydrate alkalinity due to calcium hydroxide should be permitted by the standard. This amount of hydrate alkalinity would permit the maintenance of a high pH in the treating system of softening plants, thereby aiding the effect of the coagulants, particularly that of the iron salts. In waters where the calcium carbonate saturation is not exceeded by such treatment, the hydrate alkalinity can advantageously be permitted to remain in the finished water. Iron surfaces will be protected from corrosion; the consumer will enjoy a softened water; and no aftergrowths will

occur in the distribution system. The physiological effect of hydrate alkalinity on the human system is none other than beneficial. Limitation of the presence of alkali carbonates is not justified as local conditions should always govern.

E. Sherman Chase.* In the first instance, it seems evident from the symposium that the Treasury Standard is established primarily for application to filtered supplies of the Middle West. In other parts of the country there are chlorinated but unfiltered impounded supplies and also untreated ground water supplies. Interpretation of bacteriological analyses must vary with the source of supply and manner of development. It is too often forgotten that water analyses more nearly resemble the diagnostic tests of the physician than the exact determinations of the metallurgical chemist.

Ever since the test for coliform organisms became common practice in water examination, water chemists have worshiped blindly at its shrine. This worship has continued in spite of the fact that the bacteriologists never seem content with their terminology, let alone their methods. Furthermore, the significance of the coliform organisms continues to be subject to differences of opinion, particularly when quantitative as well as qualitative concepts are involved. Who can say, for example, that a water containing two coliform organisms per 100 ml. is unsafe and another, with one such organism per 100 ml., is safe? Does it not seem absurd then to be worrying about statistical accuracy?

While it is easy to write into a standard a requirement for the examination of 100-ml. portions, it is quite another matter to provide the equipment and personnel to meet this requirement. Inasmuch as outbreaks of water-borne disease in the United States today result from fortuitous combinations of circumstances connected with the development or distribution of water supplies, it is too much to expect that changes in the bacteriological standards will preclude to any appreciable extent such outbreaks. Far more can be accomplished by the application of preventive measures in the elimination of hazards which sanitary inspections would disclose. When sewage is seen being discharged into a stream, analyses are not needed to show that the stream is polluted. When cross-connections exist between a polluted private supply and the public supply, analyses

* Consulting Engineer, Metcalf & Eddy, Engineers, Boston, Mass.

may or may not detect the hazard, but inspection will. If the Federal Standard is to be revised, more stress should be laid on those portions dealing with "Sources and Protection." In general, money spent for sanitary inspection will do more good than the same amount spent on increased laboratory activity.

Limiting the permissible occurrence of coliform organisms in drinking water supplies has been of real value and the above argument must not be construed as complete denial of the value of bacterial standards. The argument is primarily to point out that knowledge of sanitary control of sources, purification methods and distribution systems is fully as important as bacteriological analyses.

Ralph E. Noble.* The proposed change in the bacteriological standard for safe drinking water requires careful consideration from several angles. Already discussion has brought out some of these. There are certain additional points in relation to a change in standard important to water workers in the Chicago area as well as to others who may be dealing with unfiltered supplies treated only with chlorine. As yet, a discussion of these has not been noted. Before taking these up, however, it is desired to consider briefly an objection that has been voiced against the suggested change.

It has been stated that to change the standard as outlined by the committee would place undue emphasis on individual samples (see symposium in October, 1941, JOURNAL). Whether or not such emphasis would obtain, does not the nature of the problem call for such emphasis? Theoretically it requires only one disease germ to penetrate a line of defense and effect unpredictable havoc. If, in a moment of defense weakness, one disease germ does get into a supply and kills one person, that possibility should be sufficient consideration to justify so-called undue emphasis on individual samples. Or are there no weak moments, or weak spots, in water treatment processes?

No matter how long and how well a supply has been rated, only one break-through is necessary to ruin that record and to injure or kill persons. Let us be reminded of the gastro-enteritis outbreaks reported from different parts of the country, appearing but not satisfactorily proved to be of water-borne origin. Perhaps the best remembered one is that which occurred at Milwaukee, Wis., in March,

* Principal Bacteriologist, Laboratories Section, Chicago Health Dept.

1936. *If* the drinking supply was involved, it is reasonable to suppose that larger size test portions of the drinking water *might* have provided earlier signals of danger. For the reasons cited, we are inclined to favor so-called undue emphasis on individual samples.

Necessary Adjustments in Procedure

Another objection to the proposed revision has been made from the standpoint of the mechanics involved. Laboratories are now equipped with sample bottles, test tubes and pipettes for examining 10-ml. portions. It is true that some change or adjustment in procedure would be necessary. This can be minimized considerably, for example, by the use of five-normal lactose broth and Cowles fermentation tubes in standard wide-mouth four-ounce bottles,† *provided* no adverse conditions are imposed on the growing organisms by this particular combination of inoculum and medium.

It is a fact that whether or not coliform organisms are present in drinking water, other vegetative bacteria or bacterial spores may also be present. It is known that these extraneous bacteria may "over-grow" coliform types depending on conditions in the fermenting culture. These conditions involve many factors. Empirically, at least, it is known that sometimes coliform recoveries are made from 1-ml. or smaller test portions but not from corresponding 10-ml. portions, presumably due to "over-growth." The frequency of this phenomenon would be functioned, at least in part, by the ratio of coliform organisms to extraneous bacteria, at given coliform levels. Some data (presented by the author in the July, 1941, JOURNAL) suggest that this phenomenon may directly affect the efficiency of a given number and size of test portions used for measuring the coliform content of water. It is conceivable, therefore, that 100-, 50-, or 10-ml. portions, at times, may not truly reflect the coliform content. From this it may be reasoned that 10-ml. test portions will serve for index purposes better than 100-ml. size portions because the latter probably would be first affected by "over-growth." This view would hardly be tenable, however, because the condition of the water thus reflected should not be permitted to develop beyond the point of maximum efficiency of the 100-ml. test portions as compared with the 10-ml. size.

†COWLES, PHILIP B. A Modified Fermentation Tube. J. Bact., **38**: 677 (1939); Jour. A. W. W. A. Abstracts, **32**: 701 (1941).

There is need for more data regarding the effect of "over-growth" on coliform indices from 0.1 to 2.0 per 100 ml. or a little higher, in different waters. Until more is learned about it as a definite factor in bacteriological water analysis, we feel the meager information available suggests a point in favor of using 100-ml. portions for testing finished waters.

In connection with a revision of standard methods, the work by Burns* and the unpublished work by others, indicate it is timely to consider seriously the use of a suitable supplementary procedure designed to identify borderline pathogenic organisms, belonging to the *Pseudomonas*, *Alkaligenes*, *Proteus*, *Salmonella*, *Shigella* and *Eberthella* groups, particularly the first two, in finished waters, especially those from supplies receiving only chlorine treatment.

*Burns, William E. Supplemental Techniques Used in Bacteriological Studies of Water Supplies. J. Bact., **42**: 146 (1941); Jour. A. W. W. A. Abstracts, **33**: 1850 (1941).

Pages 2227 ff., the résumé of the 1941 Convention and Section Meetings and the Index of the 1941 Journal, *will be found immediately following the "Tentative Specifications for Cold Water Meters—Displacement Type."*

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American Water Works Association

TENTATIVE SPECIFICATIONS
for
COLD WATER METERS

DISPLACEMENT TYPE

The American Water Works Association has approved and promulgates these "Tentative Specifications for Cold Water Meters—Displacement Type." They are based upon the best known experience and are intended for use under normal conditions. They are not designed for unqualified use under all conditions and the advisability of use of the material herein specified for any installation must be subjected to review by the engineer responsible for the installation in the particular locality concerned.

Approved by the Board of Directors of the A. W. W. A.
November 1941

First Printing, December 1941

AMERICAN WATER WORKS ASSOCIATION
22 East 40th St., New York, N. Y.

FOREWORD

These *tentative* specifications were prepared by a committee of the American Water Works Association consisting of S. F. Newkirk, Jr., Chairman, Edw. V. Buchanan, James G. Carns, Jr., A. P. Kuranz, H. W. Niemeyer, H. V. Pedersen, George Read, George J. Rohan, George C. Sopp, L. S. Vance and W. Victor Weir. The committee has had the benefit of the technical experience of the Meter Manufacturers' Advisory Sub-Committee consisting of Chas. Bachmann, Chairman, R. R. Anderson and A. R. Whittaker. The New England Water Works Association has appointed a committee consisting of Richard H. Ellis, Chairman, Warren A. Gentner and D. H. Hall, which group has co-operated fully in the preparation of these specifications and will make proper recommendations to the N.E.W.W.A. concerning approval by that organization.

These *Tentative* Specifications have been approved by the A.W.W.A. Committee on Water Works Practice by letter-ballot dated August 26, 1941. They have also been approved by the Board of Directors of the A.W.W.A. by letter-ballot dated October 31, 1941. No member of either the Committee on Water Works Practice or the Board of Directors voted "no" in reference to the Tentative Specifications as a whole. Exceptions to certain items were noted by one of the twelve members of the Committee on Water Works Practice and by three of the thirty-three members of the Board of Directors. The exceptions noted were:

(1) To Table 1 which allows a maximum of 435 nutations per cubic foot measured; (2) to Table 1 which sets the minimum flow to be tested of $\frac{1}{4}$ gal. per min. for a $\frac{5}{8}$-inch meter; (3) to Sect. 1-3.2 which allows, as an alternate, the use of protective treated iron or steel bolts on $1\frac{1}{2}$-inch and larger meters; (4) to Sect. 1-5 which establishes 150 lb. as the maximum working pressure for which meters shall be designed; and (5) to the note at the end of the specifications which allows ten years as the maximum period of recommended operation between tests of $\frac{5}{8}$-inch meters. These exceptions will be reviewed when the specifications are considered for approval as *Standard*.

Effective Date: These "*Tentative* Specifications for Cold Water Meters—Displacement Type" *on January 1, 1943,* will supersede the "Standard Specifications for Cold Water Meters—Disc Type" adopted by the A.W.W.A. June 9, 1921. They may, in the meantime, be used as a basis of purchase of water meters whenever their use is agreed to by the customer and the manufacturer.

TABLE OF CONTENTS

Foreword ii

Scope of Specifications—Sect. 1-1

SECTION

Scope 1-1.1
Kind and Type 1-1.2

Capacity, Size and Length—Sect. 1-2

Capacity 1-2.1
Size 1-2.2
Length 1-2.3

Design—Sect. 1-3

Cases 1-3.1
Frost Protection Devices 1-3.1.1
External Case Bolts 1-3.2
Connections 1-3.3
Connections for $\frac{5}{8}$-, $\frac{3}{4}$- and 1-Inch Meters 1-3.3.1
Connections for $1\frac{1}{2}$- and 2-Inch Meters 1-3.3.2
Connections for 3-, 4- and 6-Inch Meters 1-3.3.3
Registers 1-3.4
Round-Reading Registers 1-3.4.1
Straight-Reading Registers 1-3.4.2
Register Boxes 1-3.5
Intermediate Gear Trains 1-3.6
Measuring Chambers 1-3.7
Pistons 1-3.7.1
Strainers 1-3.8
Seal Wire Holes 1-3.9

Registration—Sect. 1-4

Registration 1-4

Pressure Test—Sect. 1-5

Pressure Test 1-5

Workmanship and Materials—Sect. 1-6

Workmanship and Materials 1-6

Rejected Meters—Sect. 1-7

Rejected Meters 1-7

Sample Meter—Sect. 1-8

Sample Meter 1-8

NOTES

Tests 1
Testing Equipment 2
Care of Meters 3
Bronze 4
Rubber 5

TENTATIVE SPECIFICATIONS FOR COLD WATER METERS—DISPLACEMENT TYPE

Section 1-1—Scope of Specifications

1-1.1 *Scope.* These specifications embrace the various types and classes of cold water displacement meters for general water works service and cover the materials and workmanship employed in their fabrication.

1-1.2 *Kind and Type.* The kinds of meters covered are displacement meters known as reciprocating, rotating, oscillating and nutating piston meters. These meters are practically positive in action and the pistons displace or carry over a fixed quantity of water for each stroke, revolution, oscillation or nutation.

Section 1-2—Capacity, Size and Length

1-2.1 *Capacity.* Capacity or delivery classification shall be the quantity given in Table 1, Column 2, and is determined by the quantity delivered at the permissible maximum loss of head.

Meters 1 in. and smaller shall have a loss of head not exceeding 15 lb. per sq.in. and larger meters a loss of head not exceeding 20 lb. per sq.in., when the rate of flow is that given in Table 1, Column 2.

1-2.2 *Size.* The size of the meter given in Table 1, Column 1, shall be in terms of the nominal size of opening in the inlet and outlet spuds or flanges of the meter.

1-2.3 *Length.* The length of the meter, given in Table 2, Columns 2 and 3, shall be the overall distance, face to face of spuds or flanges.

Section 1-3—Design

1-3.1 *Cases.* All meters shall have an outer case with a separate measuring chamber in which the piston operates. The outer case for all 2-inch and smaller meters shall be of bronze composition.

The outer cases for meters larger than 2 in. shall be of bronze composition or of cast iron protected by a non-corrosive treatment. Castings shall not be repaired, plugged, brazed or "burned in." Cast-iron frost bottoms, protected by non-corrosive treatment, may be provided.

TABLE 1

(1) METER SIZE	(2) SAFE MAXIMUM OPERATING CAPACITY	(3) MAXIMUM LOSS OF HEAD	(4) MINIMUM TEST FLOW	(5) NORMAL TEST FLOW LIMITS	(6) SPEED OF PISTON, REVOLUTIONS OR NUTATIONS PER CUBIC FOOT
in.	*g.p.m.*	*lb. per sq.in.*	*g.p.m.*	*g.p.m.*	
$\frac{5}{8}$	20	15	$\frac{1}{4}$	1 to 20	435
$\frac{3}{4}$	30	15	$\frac{1}{2}$	2 to 30	250
1	50	15	$\frac{3}{4}$	3 to 50	115
$1\frac{1}{2}$	100	20	$1\frac{1}{2}$	5 to 100	50
2	160	20	2	8 to 160	30
3	300	20	4	16 to 300	15
4	500	20	7	28 to 500	7
6	1000	20	12	48 to 1000	3

TABLE 2

(1) METER SIZE	METER LENGTH (2) Screw Ends	METER LENGTH (3) Flange Ends	(4) TAIL PIECE LENGTH	MAXIMUM INDICATION OF INITIAL DIAL (5) Cubic Feet	MAXIMUM INDICATION OF INITIAL DIAL (6) Gallons	MINIMUM CAPACITY OF REGISTER (7) Cubic Feet	MINIMUM CAPACITY OF REGISTER (8) Gallons
in.	*in.*	*in.*	*in.*			*in millions*	*in millions*
$\frac{5}{8}$	$7\frac{1}{2}$		$2\frac{3}{8}$	1	10	0.1	1
$\frac{3}{4}$	9		$2\frac{1}{2}$	1	10	1	10
1	$10\frac{3}{4}$		$2\frac{5}{8}$	10	100	1	10
$1\frac{1}{2}$	$12\frac{5}{8}$	13		10	100	10	100
2	$15\frac{1}{4}$	17		10	100	10	100
3		24		10	100	10	100
4		29		100	1,000	100	1,000
6		$36\frac{1}{2}$		100	1,000	100	1,000

All meters shall have cast on them, in raised characters, the size and model. The direction of the flow through the meter shall be properly indicated. Meters larger than 1 in. shall be designed for easy removal of all interior parts without disturbing the connections to the pipe line.

1-3.1.1 *Frost Protection Devices.* The cast-iron bottom caps of frost-proof meters or other frost protection devices shall be of such

design that they will break or yield under normal freezing conditions before damage is done to any other part of the meter.

1-3.2 *External Case Bolts.* All external bolts or cap bolts, including washers, on 1-inch and smaller meters shall be of non-ferrous material (except that when breakable washers are used for frost protection the bolts and washers shall be made of suitable materials). Bolts and washers on $1\frac{1}{2}$ inch and larger meters shall be of non-ferrous material, or protective treated iron or steel. Nuts shall be of non-ferrous material and be designed for easy removal after having been long in service.

1-3.3 *Connections.*

1-3.3.1 *Connections for $\frac{5}{8}$-, $\frac{3}{4}$- and 1-Inch Meters.*

Spuds of meters shall have straight threads conforming to the American Standard (National Standard) screw threads (ASA B1.1—1935) $\frac{3}{4}$ in. for $\frac{5}{8}$-inch meters, 1 in. for $\frac{3}{4}$-inch meters and $1\frac{1}{4}$ in. for 1-inch meters. The pitch diameters for $\frac{5}{8}$-inch spuds shall be between 0.978 and 0.988 in.; for $\frac{3}{4}$-inch spuds, between 1.227 and 1.237 in.; and for 1-inch spuds between 1.563 and 1.573 in.

Coupling nuts shall be made of bronze or brass composition, and shall be tapped American National (ASA B1.1—1935) straight thread. The pitch diameter for $\frac{5}{8}$-inch coupling nuts shall be between 0.992 and 1.002 in.; for $\frac{3}{4}$-inch coupling nuts between 1.242 and 1.252 in.; and for 1-inch coupling nuts between 1.584 and 1.595 in.

Coupling tail pieces shall be made of bronze or brass composition. For $\frac{5}{8}$-inch meters they shall be threaded $\frac{1}{2}$ in.; for $\frac{3}{4}$-inch meters, $\frac{3}{4}$ in.; and for 1-inch meters, 1 in., external thread, standard pipe size. They shall be so threaded that the American National (ASA B1.1—1935) tapered pipe-thread ring gage will screw tight by hand on the tail piece until the end of the gage is flush with the end of the thread. Overall length of tail pieces shall be as given in Table 2, Column 4.

1-3.3.2 *Connections for $1\frac{1}{2}$- and 2-Inch Meters.* Main case connections for $1\frac{1}{2}$- and 2-inch meters may be either spuds or flanges as required.

Spuds shall be tapped $1\frac{1}{2}$ and 2 in. respectively, internal thread, standard pipe size, so that an American National (ASA B1.1—1935) tapered pipe-thread plug gage will screw tight by hand into the spud until the gaging notch is flush with the face.

Flanges shall be faced and drilled and shall be either of the round or oval type as required. If of the round type they shall conform to the American 125-pound standard flange (ASA B16a—

1939) for diameter, drilling and thickness. If of the oval type, the drilling shall be on the horizontal axis, the thickness shall be at least as great as required for round flanges, and the diameter of the bolt circle shall be 4 in. for 1½-inch meters and 4½ in. for 2-inch meters. The companion flanges shall be made of cast iron, and shall be tapped 1½ and 2 in. respectively, internal thread, American National (ASA B1.1—1935) tapered pipe size. Companion flanges, gaskets, bolts, nuts, and washers shall be provided.

1-3.3.3 *Connections for 3-, 4-, and 6-Inch Meters.* Flanges shall be of the round type, faced and drilled, and the dimensions and drilling shall conform to the American 125-pound standard flange (ASA B16a—1939) for diameter, drilling and thickness. Companion flanges shall be faced and drilled and they may be standard companion flanges, flange and bell, flange and spigot, or combination of any. Standard companion flanges shall be tapped 3, 4 and 6 in. respectively, internal thread, American National (ASA B1.1—1935) tapered pipe size. Flange and bell, and flange and spigot connections shall be of cast iron and conform to the American Standard Specifications (ASA A21.2—1939) for Cast Iron Pit Cast Pipe, Class 150, approved by the American Standards Association December 1939, *as far as the specifications apply.* Companion flanges, gaskets, bolts, nuts, and washers shall be provided.

1-3.4 *Registers.* Registers may be either "round-" or "straight-" reading, indicating in cubic feet or gallons.

1-3.4.1 *Round-Reading Registers.* The register pinion and spur gears shall be firmly fastened on their spindles, shall fully mesh with each other and run freely, and shall be so constructed that they cannot become unmeshed. The spindle bearings in the top and bottom register plates shall be bushed with hard vulcanized rubber, or other non-metallic bushings. These bushings shall have sufficient depth to insure ample spindle bearing and sufficient clearance to allow the spindles to revolve freely, shall be fitted so they will not work loose, shall be removable, and shall be as nearly as possible non-warping, non-shrinking, and non-expanding in heat. The register throughout, except for the dial and index hands, shall be plated or given other protective treatment, or shall be made of material as nearly non-corrosive as possible.

The maximum indication of the initial dial and the minimum capacity of the register when indicating cubic feet shall be as given in Table 2, Columns 5 and 7, and when indicating gallons as given in Columns 6 and 8.

All the index circles including the initial circle shall be subdivided into ten equal parts. All hands or pointers shall taper to a sharp point and shall be accurately set and securely held in place.

1-3.4.2 *Straight Reading Registers.* The figures on the number wheels shall be large and distinct so they can be read easily. The register lock and side gears shall be securely fastened to their number wheel discs and hubs. The tumbler pinions shall mesh accurately at the turn-over points with the lock and side gears of the adjacent number wheels. Both main and pinion shafts shall be so secured in the register frame that they cannot get out of position. The pinion shaft shall be so designed that there is no possibility of its bending and allowing the pinion to skip at the turn-over point. All parts of the register shall be plated or given a protective treatment, or shall be made of material as nearly non-corrosive as possible.

The maximum indication of the digits appearing on the first number wheel and the minimum capacity of the register, when indicating cubic feet, shall be as given in Table 2, Columns 5 and 7, and when indicating gallons, as given in Columns 6 and 8.

There shall be a test index circle which shall be divided into 10 equal parts. The hand or pointer shall taper to a sharp point and shall be accurately set and securely held in place.

1-3.5 *Register Boxes.* Register boxes and lids shall be made of bronze composition or of the same material as the top case, with the name of the manufacturer cast on the lid in raised letters. The serial number of the meter shall be plainly stamped on the lid. If required, the serial number shall also be stamped on the case. The lid shall be recessed and shall lap over the box to prevent dirt from accumulating on the glass. The glass shall be inserted from the inside and securely held in place without the use of putty or pins. All register compartments shall be provided with a water escape hole $\frac{1}{8}$ inch in diameter.

1-3.6 *Intermediate Gear Trains.* Intermediate gear trains may be mounted on the measuring chambers or in the upper main casings. Gear train frames, spindles, gears, and pinions shall be made of durable non-ferrous material. Pinions and spur gears shall be firmly fastened, shall fully mesh with each other and shall run freely. The lower end-bearings for pinion and spur gear spindles that revolve shall be fitted with hard vulcanized rubber or other non-metallic bushings fastened in place so they will not fall or work out and shall be easily removable. Gear trains may be of either the oil-enclosed or open type. If of the oil-enclosed type, the gear trains shall have a separate housing or form a housing with the main casings or measuring chamber and shall operate in a suitable lubricant.

1-3.7 *Measuring Chambers.* The measuring chambers for all meters shall be made of bronze or non-ferrous composition and shall not be cast as part of the outer casings. They shall be machined carefully and secured in position in the outer casings so that any slight distortion of the casings which might occur under 150 lb. pressure will not affect the sensitiveness of the meters.

1-3.7.1 *Pistons.* Pistons shall be made of vulcanized hard rubber, shall be smoothly machined, shall be fitted accurately in their measuring chambers and shall operate smoothly and freely. The plates of disc pistons, whether flat or conical, shall have metal reinforcements or shall be equipped with thrust rollers. Disc pistons may be in one piece or the piston plates may be in one piece and the piston balls in two pieces. The piston spindles or shafts shall be securely fastened in the pistons.

The piston reciprocations, rotations, oscillations or nutations per cubic foot shall not exceed the quantities given in Table 1, Column 6.

1-3.8 *Strainers.* All meters shall be provided with strainers, except when self-strained by means of an annular space between the measuring chamber and the external case. Strainer screens shall be installed in the meter and shall be made of heavy sheet copper, or copper alloy, shall be perforated, shall be rigid, shall fit snugly, and shall be easily removed. They shall have an effective straining area as large as practicable and at least double that of the meter main case inlet.

1-3.9 *Seal Wire Holes.* Register box screws and inlet and outlet coupling nuts or connection flanges shall be drilled for seal wire holes. All seal wire holes shall be not less than $\frac{3}{32}$ inch in diameter.

Section 1-4—Registration

The registration on the meter dial shall indicate the quantity recorded to be not less than 98.5 per cent nor more than 101.5 per cent of the water actually passed through the meter while it is being tested at any rate of flow within the limits specified in Table 1, Column 5, under "Normal Test Flow Limits," with water having a temperature of less than 80°F. There shall be not less than 95 per cent of the actual flow recorded when a test is made at the rate of flow set forth in Table 1, Column 4, under "Minimum Test Flow."

Section 1-5—Pressure Test

Meters shall be guaranteed to operate under a working pressure of 150 lb. per sq.in. without leakage or damage to any part.

Section 1-6—Workmanship and Materials

Meters shall be guaranteed against defects in materials and workmanship for a period of one year from date of shipment. Parts to replace those in which a defect has developed within such period shall be supplied without charge, piece for piece, upon the return of such defective parts to the manufacturer thereof or upon proper proof of such defect.

Section 1-7—Rejected Meters

The manufacturer shall at his own expense replace or satisfactorily readjust all meters rejected for failure to comply with these specifications.

Section 1-8—Sample Meter

The manufacturer shall upon request submit a sample of the meter proposed to be furnished, with pressure loss curves for each size of meter.

NOTES

These notes are not part of the specifications. They are given only as information concerning the testing and care of meters and important materials used in meter construction. They are not intended to limit in any way the future development of better materials for general use nor the use of special metals with specific waters which may require materials of different composition to give service equal to that recorded in normal practice.

(1) *Tests*

Capacity tests are those which test the design of the meter. When a meter of a given design has once been tested for capacity it should not be necessary to test this type of meter again unless a change has been made in the design.

Registration tests are those which test the assembly and workmanship of the meter. Each meter should be tested for registration as there is no certainty that, because one meter of a given design is within certain limits of accuracy, all meters of this design will necessarily give similar results. The register furnished with each meter should be used by both the manufacturer and the purchaser in making registration tests.

All meters should be tested for accuracy of registration within, and as near as practicable to, the low and high rates given under "Normal Test Flow Limits," and occasionally additional tests should be made at one or more intermediate points. A test at the "Minimum Test Flow" should be made on as many as possible, and not less than 5 per cent of the meters. If the results obtained from testing 5 per cent of the meters show that any meter does not comply with the low flow requirement, additional meters should be tested to the

extent deemed necessary to make certain that the other meters do comply therewith.

A pressure test should be made on each size of meter of a particular design furnished. This pressure is to be 150 lb. per sq.in., which may be obtained by the use of a hand pump or any method available. The meter should be tested for accuracy before and after it has been tested by static pressure to determine whether there has been any distortion that would affect the registration. It is unnecessary to make more than one pressure test on each size of a given design if satisfactory results are obtained. A working pressure test is preferable to a static pressure test.

If the purchaser has no testing equipment, a certificate should be furnished by the manufacturer showing that each meter has been tested for accuracy of registration and that it complies with the specifications and that the size and design complies with the capacity requirements.

(2) *Testing Equipment*

The minimum test equipment is as follows:

(a) A valve on the supply line which would permit the starting and stopping of the flow without appreciable loss of time.

(b) A valve or other suitable device on the discharge line which can provide the rate of flow desired.

(c) Pressure gages on supply and discharge pipes so any change in pressure which would affect the rate of flow can be detected. The discharge pipe must be under sufficient head to guarantee a pressure on the outlet of the meter.

(d) A measuring device of either the volumetric or weighing type. The accuracy of the determination of the amount of water discharged should be such as to bring the limit of error within 0.25 per cent. The amount of water passed should be sufficient to cause at least one revolution of the pointer on the initial dial except for the test at the "Minimum Test Flow" rate. The amount passed at the "Minimum Test Flow" rate should be of sufficient quantity to secure a true indication of the accuracy.

(e) Two piezometer rings of exactly the same diameter for capacity tests. The piezometer rings must be free from any burrs where the holes are drilled through the wall of the ring, and not fewer than four holes shall be provided, drilled in pairs on diameters at right angles to each other. The inlet ring shall be set close to the meter at a distance of eight diameters or more below the nearest upstream stop valve or fitting, and the outlet ring shall be placed at a distance of between eight and ten diameters from the outlet of the meter. The diameter of the rings, the inlet and the outlet pipes shall be the same as the size of the meter to be tested. The rings are to be connected to a mercury U-tube, equipped with an accurate adjustable scale for measuring the difference in mercury level, by rubber or metallic tubing. Provision is to be made for the complete removal of air from the U-tube and tubing connected therewith and the installation is to be such that air will rise to the air outlets. Where relatively high flows are to be measured, it is necessary to read both sides of the mercury column simultaneously to compensate for irregularities in the diameter of the glass U-tube, and to avoid errors due to fluctuations.

Suitable pressure gages may also be used.

(3) *Care of Meters*

In a displacement meter the motion of the piston is transmitted by a system of gearing to the register where the flow is recorded in convenient units of measure, as cubic feet or gallons. The gearing serves to translate the motion of the piston into the unit of measure indicated by the register. The register is at all times a measure of the number of revolutions, oscillations or nutations of the piston in terms of cubic feet or gallons. It records a true measure of flow only when the meter has been properly calibrated by gear adjustment, and after proper calibration will continue to register correctly only as long as the piston continues to make the proper number of cycles for each unit of quantity passed through the meter. If, after calibration, any condition should develop whereby the piston is compelled to make less than the proper number of cycles per unit of quantity passed through it, the meter will under-register. If the piston is compelled to make more than the proper number of cycles, the meter will over-register. The proper number of cycles is the number made at the time the meter is calibrated. Under ordinary working conditions, there are a number of factors that may cause under- or over-registration after comparatively short intervals. The more important of these factors which should be guarded against to secure proper registration are:

(a) *Excessive Wear.* Excessive wear of the moving parts of the meter may be caused by improper setting, by over-speeding, or, in general, by the selection of a meter too small for the work required. The effect of excessive wear of the piston or measuring chamber is to cause slippage and under-registration. Excessive wear of the intermediate gear train may cause binding of the gears, or gear slippage. In any case, if the meter is not stopped entirely, under-registration will result. To avoid excessive wear, meters should be set in a horizontal position and should not be run at destructive speeds. The capacity of the meters given in the specifications represents the maximum rates of flow at which water should be passed through meters for short periods of time or the peak loads which should come upon meters only at long intervals. These rates would be destructive under continuous service. For continuous 24-hour service meters of the displacement type should not be operated on flows greater than one-fifth of the capacity of the meter.

(b) *Temperatures.* High temperature causes the rubber pistons to expand, tending to create unusual friction or to bind the piston in its chamber. The effect is to cause slippage and under-registration, or failure of the meter. Low temperature has no noticeable effect on the working parts of the meter. Freezing will stop the meter and possibly damage it.

Cold water meters are not affected by temperatures up to about 80°F. In warm climates where the temperature of the water is likely to go above 80°F., meters with clearances slightly larger than ordinary should be used, and accuracies indicated in the specifications must be modified accordingly.

To avoid troubles caused by temperature, meters should be set at locations where they will be protected from heat and frost. At locations where hot water from heating systems may be forced back through the meter, a check and relief valve should be installed on the outlet side of the meter.

(c) *Corrosion.* All the metals used in the construction of a meter are affected by the corrosive action of water. The action is very slow with most potable waters. The effect is to weaken parts of the meter, particularly the

teeth of the open intermediate gears, and to tend to bind meters that are idle for long intervals.

(d) *Material in Suspension.* Foreign material carried in suspension has a tendency to fill the space between the piston and measuring chamber and cause over-registration. Such over-registration, however, is limited and cannot generally exceed 3 per cent.

Meters are provided with strainers which retain the larger particles of material in suspension, but the strainer will soon become clogged if the water is not kept reasonably free of suspended matter. Sand is especially destructive and care should be exercised to keep sand from reaching the supply pipes.

The finer particles of suspended material cannot be prevented from reaching the meter and troubles from this source can be avoided only by cleaning the meter periodically, the interval between cleanings depending upon the quality of the water.

(e) *Periodic Tests.* Meters properly selected as to size and type, will give satisfactory service over a long period of time without attention only when operated under ideal conditions. Under ordinary conditions meters must be given some care if they are to function properly. In most cases it is impossible to ascertain, without actual test, whether a meter which has been in service is registering within the required degree of accuracy. Consequently, to insure reliable meter measurements, it is essential that all meters be subjected to periodic tests. The interval between tests and the method of conducting them must be governed largely by local conditions. Under *average* conditions the following intervals between tests should not be exceeded:

Meter Sizes–Inches	*Years Between Tests*
$\frac{5}{8}$	10
$\frac{3}{4}$	8
1	6
$1\frac{1}{2}$	4
2	4
3	3
4	2
6	1

Many state regulatory commissions specify the intervals between tests on both a time and quantity basis.

(4) *Bronze.* A bronze which is satisfactory for most waters is that of Specifications B62-36 of the American Society for Testing Materials or No. 2 Federal Specifications QQ-B-691a for an alloy of copper, tin, lead and zinc known commercially as composition metal, 85-5-5-5, ounce metal, red brass or hydraulic bronze.

(5) *Rubber.* A satisfactory rubber for pistons and bushings should, among other items, have a specific gravity under 1.2, a minimum tensile strength of 6,500 lb. per sq.in., a maximum elongation of 5 per cent, a hardness (scleroscope test) of not less than 67, a free sulfur content of 3 per cent or less, a free ash content of not more than 3 per cent and a uniformity of cure and physical characteristics.

The 1941 Convention

TORONTO has been host to the American Water Works Association upon two previous occasions—1907 and 1929. The 1929 meeting is remembered by many as the opening convention in the Royal York Hotel—the largest in the British Empire.

The 1941 Convention was housed in that same hotel and found the facilities again adequate for housing, meetings, exhibits and the general social functions.

The attendance at conventions of the American Water Works Assotion from 1929 through 1941 is as follows:

Year	*City*	*Total Registered*	*Year*	*City*	*Total Registered*
1929	Toronto	1,104	1935	Cincinnati	901
1930	St. Louis	1,021	1936	Los Angeles	891
1931	Pittsburgh	1,076	1937	Buffalo	1,140
1932	Memphis	712	1938	New Orleans	1,123
1933	Chicago	660	1939	Atlantic City	1,290
1934	New York City	891	1940	Kansas City	1,467
			1941	Toronto	1,445

The Convention Management Committee consisted of:

Representing the A.W.W.A.

Wm. J. Orchard, *Chairman*
Reeves Newsom
A. E. Berry

Representing the W. & S. W. Mfrs. Assn.

Clinton Inglee
J. Herman Smith

Ex-Officio

Norman J. Howard, Pres., A.W.W.A.
Harry E. Jordan, Secy., A.W.W.A.
Linn H. Enslow, Chr., Publ. Comm.
Karl M. Mann, Pres., W. & S. W. Mfrs. Assn.
John A. Kienle, Secy., W. & S. W. Mfrs. Assn.

Canadian Section Committees. No finer co-operation has ever been given in the arrangements for and handling of a convention than the Canadian Section Members gave the A. W. W. A. at Toronto. The Section Committees and their chairmen were:

Local Convention Committee,	
Honorary Chairman	R. C. Harris
Chairman	A. E. Berry
Vice-Chairman	W. T. Randall
Local Host Committee	R. L. Dobbin
Ladies Rendezvous Committee	Mrs. Wm. Storrie
	Mrs. R. C. Harris
Water Works "Get-Together"	Mr. and Mrs. E. V. Buchanan
President's Reception and Dance	Mr. and Mrs. C. J. Des Baillets
Ladies Tea	Mrs. J. B. Kinney
All Section Dinner	J. Clark Keith
Ladies Luncheon Bridge	Mrs. A. U. Sanderson
"Canada" Night Committee	W. T. Randall
Dinner Dance	Mr. and Mrs. A. U. Sanderson

Convention Program. Publication Chairman L. H. Enslow and his committee arranged a fully adequate technical program. Those in attendance were given authoritative information concerning wartime problems of water supply and at the same time were provided with material concerning regular operating practices.

Attendance at technical sessions represented a smaller percentage of those in attendance at the convention than was the case either at Atlantic City or Kansas City. The maximum number in attendance at any session in Toronto was 302—at the close of the opening general session. The peak attendance at Atlantic City was 347 and at Kansas City 577.

It is believed that auditorium sessions have demonstrated a greater drawing power than technical sessions in hotels.

Entertainment. Clinton Inglee guided the entertainment activities. Mrs. William Storrie was Chairman of ladies entertainment and was not only a most gracious hostess but one who developed a fine co-operative spirit among her sister Canadians.

The feature of the Tuesday Evening All-Section Dinner was an address by Willard Chevalier—Publisher of Business Week. His subject was "National Defense and the Individual."

Exhibits. It had been anticipated that defense activities would materially reduce the extent of the exhibits. As a matter of fact, however, 78 exhibitors used the 110 booths that had been set up on the convention floor and there was no room in the area for additional exhibits. Naturally less floor space was used than at either Kansas City or Atlantic City but the variety of materials exhibited was fully as diversified.

Publicity. Grant Richmond of Toronto handled public relations during the convention. Adequate newspaper lineage was given to the convention by the Toronto press. Pre-convention promotion was directed by Joseph M. Wafer. His report of his work says in part:

"Trade publications were approached to contribute space in promoting attendance for the Toronto Meeting. The publications, as usual, were very co-operative in the donation of space and the making up of their own copy which was approved by your Chairman before publication. In addition to the donation of paid space, they were very generous in their news items, editorials and other matter, all of which contributed to the fine showing that was made.

"In connection with the work of the Transportation Committee, the New York Central Railroad put out a folder which was mailed to all the Members of the American Water Works Association, in the United States and Canada, outlining the train schedules from all the key points in the United States. These mailing pieces acted as a reminder or could essentially be considered as a 'Promotional' piece.

"The Major oil companies in Canada sent out a letter outlining the beauties of Canada, etc., and offered their co-operation in furnishing Road Maps, etc., to those who were going by auto transportation. This acted as a further reminder for 'Promotional' purposes.

"The Secretary of the American Water Works Association sent out a general broadside to all the Members, giving complete information in regard to Customs Regulations, Tentative Program and other matters of interest.

"The Registration at Toronto, of course, indicates that the Meeting was very successful. How much the promotional activities under your Chairman affected the attendance, naturally, is hard to say, but it is reasonable to note that with constant efforts on the part of all, the attendance has been increasing."

Toronto Inspection Trips. The war interfered with free visiting about Toronto Water Works properties.

The Water Department made arrangements for attendants at the convention to visit the new Victoria Park filtration plant in small groups throughout the convention. The arrangements were quite satisfactory.

Presentation of Awards

Honorary Membership was conferred upon Messrs. J. Walter Ackerman, R. C. Harris and Frank C. Jordan. The citations were:

J. Walter Ackerman, retired Chief Engineer of the water department of Utica, N. Y., a member of the Association since 1910; a Trustee in 1930; Director, 1931–2. An active participant in the affairs of the New York Section as well as the general Association; one who has given excellent service to the communities in which he has been engaged.

R. C. Harris, Commissioner of Works at Toronto for twenty-eight years; a member of the A.W.W.A. since 1913; oldest living Past-Chairman of the Canadian Section, over which he has held a guiding hand throughout its existence.

Frank C. Jordan, for many years Secretary of the Indianapolis Water Company; a member of the Association since 1911; Trustee, 1920–22; Vice-President, 1924; President, 1925; Fuller Awardee, 1940; a leading spirit in the organization of the Indiana Section, Secretary of the group during its earlier years; one who has led in his community and in the nation in promotion of the efficiency of water departments in reducing losses from fire.

The John M. Diven Medal, annually awarded to the member whose services to the Association are deemed most outstanding, was presented to William W. Hurlbut with the following citation:

William W. Hurlbut of Los Angeles, for his successful leadership of the Steel Pipe Committee to the completion of a series of specifications for steel pipe and protective coatings. He has rendered conspicuous service to the entire water supply field.

The John M. Goodell Award, for the best paper published in the JOURNAL of the Association, was presented to:

Paul Weir of Atlanta, Ga., for his paper on "The Effect of Internal Pipe Lining on Water Quality," printed in the September 1940 issue of the JOURNAL. The author of this paper has made a notable con-

tribution to water works knowledge. He has done well in planning his research, recording and analyzing his data, and stating his conclusions thereon.

George W. Fuller Memorial Award certificates were presented to the following members:

California Section—*William Whitehead Hurlbut:* For his organization and leadership of committees in the Section, as well as in the general Association; for his tireless promotion of membership in the A.W.W.A.; and for his services in the advancement of the best water works practice.

Canadian Section—*Walter Moffat Scott:* For his outstanding contributions as a consulting engineer on power developments and municipal projects; and in recognition of his meritorious management of the Greater Winnipeg Water District.

Florida Section—*Ralph Whitney Reynolds:* In recognition of his long and distinguished service in the water works field and his constructive leadership in the Florida Section as Member, Chairman and Director.

Four States Section—*Ivan Maxwell Glace:* In recognition of his efforts put forth for the benefit of water works operators; and for his leadership in the water works field in the State of Pennsylvania.

Illinois Section—*Frank Clifford Amsbary, Jr.:* In recognition of his valuable services to the water works profession, the American Water Works Association, and the community in which he lives.

Indiana Section—*Paul Carl Laux:* In recognition of his pioneer work and constructive leadership in district meetings; for the training of water works operators; and for his development of a flash test for the control of break-point chlorination.

Kentucky-Tennessee Section—*John Powers Brownstead:* For his excellent progress in rebuilding and improving his water plant and system against flood and improving the quality of his city's water supply.

Michigan Section—*Walter Leroy Mallman:* For his inspiring leadership as a teacher of bacteriology to water plant operators attending the Michigan short course; and for his effective research in laboratory technique and methods in water bacteriology.

Minnesota Section—*Felix Seligman*:* For his activity in the advancement of water works practice over a long period of years; for his spirit of co-operation; his effort in research on problems of water supply; the high standard attained in the water supply under his supervision; and for his work in the A.W.W.A.

Montana Section—*William Merriam Cobleigh:* For his leadership in the promotion of adequate and sanitary water supplies in the State of Montana; for his co-operation in founding and conducting the Montana Water Works School.

Missouri Valley Section—*David Leonard Erickson:* For his meritorious reorganization and advancement of the Lincoln Water Department; his skillful solution of the water treatment problem; the development of a new source of supply for the City of Lincoln; and, for his unselfish service to the Missouri Valley Section and the American Water Works Association.

New Jersey Section—*George Riddell Spalding:* For his meritorious work in water purification, particularly as evidenced by his work on activated carbon—following his experiments the use of powdered activated carbon gradually became an accepted method of taste reduction in water filter plants in this country.

New York Section—*Robert Gordon Yaxley:* For his contributions toward the advancement of water works practice within the New York Section; for his enthusiastic search for improved methods; for his initiative in executing their practical application; and, for his co-operative spirit in stimulating interest in the supervision and operation of public water supplies.

Ohio Section—*Michael Frank Hoffman:* In recognition of his outstanding activities in the development of the Ohio Section and the conduct of its affairs.

Pacific Northwest Section—*William Parker Hughes:* In recognition of his leadership qualities; and for his contributions toward the advancement of water works practice.

Southeastern Section—*James Edwin Gibson:* For his distinguished leadership in water supply construction in North America; for his effective administration of water supply systems in the City of Charleston; and for his worthy contributions to the activities of the A.W.W.A.

* Deceased May 29, 1941.

Southwest Section—*Victor Marcus Ehlers:* In recognition of his untiring effort and success in organizing the Texas Short Course School for Water Works Operation.

Western Pennsylvania Section—*Chester Francis Drake:* For his long and distinguished service in the water purification field; and his contributions to the laboratory control of water treatment.

West Virginia Section—*John Bert Harrington:* For his outstanding work in the advancement of water purification in West Virginia; and for his leadership in the licensing of water plant operators.

Wisconsin Section—*Arthur Peter Kuranz:* For outstanding work in developing meter testing methods and meter maintenance procedure.

1940

Illinois Section—*Charles Herbert Spaulding:* In recognition of his many outstanding contributions toward improvement of the quality of public water supplies.

Kentucky-Tennessee Section—*Howard Dean Schmidt:* For his activity in the conduct of schools for water works plant operators and the inauguration of a program for the certification of water works operators in Tennessee.

Missouri Valley Section—*August Vincent Graf:* For his research and contributions to water purification and water works practice; and for his generous assistance to younger men in the water works field.

Pacific Northwest Section—*Ben Stogden Morrow:* In recognition of his efficient service in the financial and technical administration of the Portland Water Works System.

No Fuller Memorial Awards were made by the Cuban, New England, North Carolina, Rocky Mountain and Virginia Sections during the period between the Kansas City and the Toronto Conventions.

The Nicholas S. Hill Cup, awarded annually to the Section making the greatest percentage gain in membership from one general convention to the next, was won by the Pacific Northwest Section. Its gain was 24.26 per cent. Following in order were the Cuban Section (20.69 per cent gain) and the Western Pennsylvania Section (18.52 per cent gain).

The Henshaw Cup, awarded annually to the Section having present at its annual meeting, the greatest per cent of its membership, was also won by the Pacific Northwest Section. At its 1940 meeting, 78.01 per cent of its membership attended. There followed the Montana Section (76.19 per cent) and the Minnesota Section (71.43).

The Old Oaken Bucket was for the third time given to the California Section as the Section having the largest total membership (536). This trophy will remain in the possession of the California Section until some other Section achieves a greater membership total.

Schedule of Papers and Reports

General Session—9:30 A.M.—June 23, 1941

General Announcements.
The Defense of Water Supply Works in Wartime.....Norman J. Howard
Emergency Radio Communication.....W. Victor Weir
Chlorination Equipment Available for Emergency Use.....Harry A. Faber
Experiences in the Use of Emergency Chlorination Equipment
Gerald E. Arnold

General Session on Plant Management—2:00 P.M.—June 23, 1941

State Wide Plans for Water Supply Defense.....H. T. Critchlow
Regional Water Supplies.....Abel Wolman
Factors in the Control of Reservoir Silting.....Carl B. Brown
Manufacturers' Symposium—Equipment Available for Emergency Repairs to Distribution Systems.....Clinton Inglee, H. Y. Carson, Rossiter S. Scott, Nelson Thompson

Special Session on Steel Pipe and Coatings—2:00 P.M.—June 23, 1941

Current Activities of the Steel Pipe Committee.....William W. Hurlbut
Mechanical Application of Bituminous Pipe Coatings and Linings
Laurance E. Goit
Fittings and Specials for Steel Pipe.....Russell E. Barnard
The Stone Canyon Pipe Line—A Talking Picture in Color

General Session on Finance and Accounting—9:30 A.M.—June 24, 1941

Water Rate Structures in Canada
Domestic Rates.....Albert E. Berry
Municipal Services and Fire Protection.....William Storrie
Financing and Accounting Methods in Use at Denver.....George F. Hughes
Management Problems in a Municipal Utility District.....John S. Longwell
Experiences with Federal Housing Developments.....Hal F. Smith

Water Purification Division—9:30 A.M.—June 24, 1941

Studies in Corrosion Control.....Henry P. Stockwell, Jr.
Scientific Control and Critical Appraisal of Experimental Work
John F. Norton

Viability and Destruction of the Cysts of Amoebic Dysentery
Shih Lu Chang and Gordon M. Fair
Some Applications of a New Method of Determining Residual Chlorine
Henry C. Marks and John R. Glass

Water Purification Division—2:00 P.M.—June 24, 1941

Investigating the Quality of Water in a City Distribution System
William M. Wallace and Albert M. Shannon
Revising the U. S. Standards for Drinking Water Quality—A Symposium
J. K. Hoskins, Charles R. Cox,
George D. Norcom, John R. Baylis,
Abel Wolman

General Session on Metal Protection—2:00 P.M.—June 24, 1941

Experiences with Cathodic Protection of Water Tanks.....J. Clark Keith
Experimental Studies of Tank Coating Materials.....J. O. Jackson
Applications of Cement Lining to Water Lines
Experience at Akron.....Wendell R. LaDue
Experience at Toledo.....George N. Schoonmaker
Experience at Cincinnati.....Carl A. Eberling
A Program of Research Upon the Effects of Electric Grounding on Water Pipes
Rolf Eliassen

Finance and Accounting Division—9:30 A.M.—June 25, 1941

Progress in Security and Retirement Planning for Utility Personnel
Dale L. Maffitt
Value of Adequate Civil Service to Municipal Water Plant Operation
John B. Probst
The Limitations of Civil Service.....H. A. Van Norman
Discussion by Edward V. Buchanan
Public Relations Begin at Home or A.B.V.R. Goldfish.....John C. Mellett
Report of Committee on Joint Administration and Collection of Water and Sewer Accounts.....Leonard N. Thompson
Discussion by John A. Hickey and Hal F. Smith

Water Purification Division—9:30 A.M.—June 25, 1941
Committee Reports

Activated Carbon Research.....Mathew M. Braidech
Specifications for and Methods of Testing Zeolites.....Daniel E. Davis
Methods of Determining Fluorides.....A. P. Black
Chloramination.....F. Wellington Gilcreas
Standards for Purification Plant Operation.....Edward S. Hopkins
Water Conditioning Methods to Inhibit Corrosion.....Edward W. Moore
Specifications for Filtering Material.....Paul Hansen
Methods of Water Treatment and Laboratory Control....George D. Norcom

Committee Meetings—2:00 P.M.—June 25, 1941

Deep Wells and Pumps, Open Conference, J. Arthur Carr and James C. Harding, *Co-Chairmen*

Survival and Retirement Experience with Water Works Facilities, Open Conference, Louis R. Howson, *Chairman*

General Session on Water Distribution System—9:30 A.M.—June 26, 1941

Cross-Connection Control—A Committee Report
Edward S. Chase, Chairman
The Pollution and Emergency Disinfection of Rochester's Water Supply
Earl Devendorf
A Manual of Safe Practice in Water Distribution—A Commiteee Report
William E. Stanley, Chairman
Progress in Plumbing Standardization.....M. Warren Cowles
Progress in Boiler Feedwater Research.....Richard C. Bardwell

Plant Management and Operation Division—9:30 A.M.—June 26, 1941

A Survey of Water Main Extension Policies.....Leslie A. Jackson
Development of Houston's Water Supply.....G. L. Fugate
Discussion by Louis R. Howson
Protection of Buffalo's Pumping Station Against Service Interruptions
Leonard A. Bergman
The Control of Automotive Equipment.....Louis A. Geupel

Joint Session: Plant Management and Operation Division, Finance and Accounting Division—2:00 P.M.—June 26, 1941

Relation of Meter Rates to Distribution System Conditions
Charles H. Capen, Jr.
Meter Reading & Commercial Department Operation.....Kenneth K. King
Meter Maintenance Practice.....A. P. Kuranz
Report of Committee on Meter Specifications.....S. F. Newkirk, Jr.
Special Rates and Free Water Service.....Dale L. Maffitt
Discussion led by.....Ross L. Dobbin

Papers Presented by Title Only

Toronto's New Purification Plant and Pumping Station.
A. U. Sanderson and Lawrence F. Allan
Some Problems in the Design of a Pumping Station.....Eduardo Molina
Six Centuries of Water Supply in Mexico City.....Alfonso Villa-Acosta

Papers Scheduled at Section Meetings

THERE follows a summary-listing of papers scheduled for presentation at Section meetings during 1941. The locations and dates of the 1941 Section meetings are given on page 2249. A record of the number of members and the attendance at the meetings in 1939, 1940 and 1941 is presented on page 2250. Section officers who were elected at meetings held during 1941 and who will be holding office on January 1, 1942 are listed on page iv of this JOURNAL.

California Section—Scheduled Papers

Welcome to Fresno ..... *Mayor* Z. S. Leymel
Fresno Water System ..... Claude H. Weekes
Central Valley Project ..... S. O. Harper
Financing Extensions of Water Mains ..... Morris S. Jones
Cost Accounting ..... R. M. Sedgwick
Eliminating Pump Station Noises From Distribution Mains ..... S. M. Dunn
Removal and Repair of Water Meters ..... G. W. Pracy
Transportation of Sediment Through Reservoirs ..... R. T. Knapp
Sanitary Construction and Protection of Wells ..... H. J. Ongerth
Limnological Observation on San Francisco Reservoirs ..... H. C. Medbery
Address ..... Louis R. Howson
Water Quality Problems in the Operation of Small Systems ..... Lawrence H. Cook
National Defense and Water Supplies ..... Earl Warren
Wartime Precautions in Water Supply Protection ..... R. F. Goudey
Review of Manual on Water Quality and Treatment and Manual on Treatment Plant Design ..... Chas. G. Hyde
Round Table Discussion on Water Works Subjects ..... *Led by* Samuel B. Morris
Round Table Discussion on Purification Problems ..... *Led by* C. W. Sopp

Florida Section—Scheduled Papers

Address of Welcome ..... *Mayor* U. W. Cunningham
Response and Annual Report ..... H. H. Hyman
A Nine-Meeting Review ..... William W. Brush
Civilian Defense of Public Water Supplies ..... G. E. McCallum
Some Problems of Army Water Supply ..... A. S. Behrman
The Bacteriological Quality of Florida Ground Waters ..... A. E. Williamson
Ground Waters in Southeastern Florida ..... W. P. Cross
Discussion ..... S. K. Love
Difficulties Facing Water Works Manufacturers During the Present Emergency ..... Fred E. Stuart
Progress in Aquatic Weed Control ..... C. P. Wilber

Water Works Operations Under Emergency Conditions.....Harry E. Jordan
Standards of Purification Plant Operation.....Ralph W. Reynolds
Discussion.....R. M. Johnson, H. A. Gahn, Thomas Paul, W. S. Black
The Newly Organized Florida Water Works Operators Association.....
Keith R. Chinn
The Stone Canyon Inlet-Outlet Line of the Bureau of Water Works and Supply of Los Angeles.....*A Motion Picture*
Water Supply and Treatment in Florida (*A Motion Picture*)...A. B. DeWolf
The Newly Organized Sewage Works Operators Association.....David B. Lee
Discussion.....S. W. Wells
Flow of Streams and Springs of Florida and Their Use as Industrial and Municipal Supplies.....G. E. Ferguson
Extension Division Courses for Water and Sewage Works Operators.....
G. Manuel Turner

Four States Section—Scheduled Papers

Address of Welcome.....George Cobb
The Work of the FBI Under the National Defense Plan.....E. A. Soucy
Water Supply in the National Defense.....Charles Haydock
Discussion.....Adrian Hughes
Utility Organization for Defense.....Abel Wolman
Rehabilitation of the Philadelphia Water Works.....Seth M. Van Loan
Discussion.....Nathan Jacobs
Rating of Water Distribution Systems for Fire Protection Purposes.....
A. C. Hutson
Discussion.....J. R. McComas
Address.....Louis R. Howson
Symposium on Chlorinating New Water Mains.....*Led by* Carl Hechmer
Round Table Discussion on Standards of Purification Plant Operation.....
Led by Edw. S. Hopkins
Health and the Cycle of Water.....*A Motion Picture*
Maintenance of Control Equipment in Water Filtration Plants..Alan A. Wood
Discussion.....R. A. McQuade
A Bacteriologist Looks at Chlorine.....(*Miss*) Stella M. Costigan
Discussion.....John W. Krasauskas
New Standards of Water Quality.....J. K. Hoskins
Efficiency Maintenance—Motor-Driven Centrifugal Pumps..L. V. Schuerholz
Discussion.....Stanley E. Kappe

Illinois Section—Scheduled Papers

Should We Test Larger Portions of Water for Coliform Bacteria?.....
Ralph E. Noble
Military Field Water Supplies.....Thomas T. Quigley
Protecting Water Works Structures Against Corrosion.....Horace R. Frye
An Unique Experience With Chlorine.....George B. Prindle
What a Salesman Can Offer a Water Works Operator.....Edward E. Alt
What an Operator Expects From a Water Works Salesman....L. A. Nalefski
Recent Federal and State Tax Legislation Affecting Water Works.....
Clyde H. Hunter
Water Supply Problems of the Manteno State Hospital Typhoid Fever Outbreak.....Clarence W. Klassen
Discussion.....Arthur E. Gorman

Water Treatment Plants:
- Mattoon, Illinois ..... F. L. Coventry
- Carbondale, Illinois ..... Clifford Fore
- Wilmette, Illinois ..... W. M. Olson
- Kenilworth, Illinois ..... G. H. Ruston
- Danville, Illinois ..... M. M. Symons

Pumping Stations and Distribution Systems:
- Moline, Illinois ..... A. E. Anderson
- Brookfield, Illinois ..... J. A. Pinner Jr.
- East St. Louis, Illinois ..... C. M. Roos

Report of the Committee on Control of Well Drilling ..... H. L. White
Address ..... Norman J. Howard
Address ..... Louis R. Howson
Panel Discussion—Water Supply in Relation to the National Defense ..... *Led by* H. H. Gerstein
- General Problem ..... Paul Hansen
- Protection of Water Works Against Sabotage ..... Joseph Horn
- Canadian Experiences in Protection of Water Works Plants ..... Norman J. Howard
- Building Cantonment Water Supplies Under Difficulties ..... Charles B. Burdick

Indiana Section—Scheduled Papers

Ground Water for Public Supplies in Indiana ..... C. L. McGuinness and G. F. Fix
- Discussion ..... Fred Serviss

Water Works Management ..... Louis R. Howson
Address ..... *Governor* Henry F. Schricker
Utility Co-ordination in Emergencies ..... L. A. Geupel
Our Job in Times of Stress ..... William W. Brush
Report of the Accounting Committee ..... E. C. Schwier
Meeting for Managers, Superintendents and Distribution Men ..... *Led by* F. A. Schaefer
- Report of Technical Committee ..... F. A. Schaefer
- Manual on Paints ..... W. E. Howland
- Round Table Discussion—Value of Foresight in Water Works Operation ..... *Led by* John L. Ford
- Meter Settings ..... T. E. Milligan
- Round Table Discussion—Selling the Advantages of a Maintenance Manual ..... *Led by* Clyde Williams
- A 100% Meterization Program ..... Everitt Robbins

Meeting for Filter Operators and Others Interested in the Production of Water ..... *Led by* J. C. Vaughn
- Break-Point Chlorination ..... Jack Nickel
- The Cleaning and Handling of Filter Sand ..... M. P. Crabill
- Studies in Coagulation ..... Richard H. Coote
- Sanitary Problems in Well Supplies ..... J. D. Richetta

Meeting for Those Interested in Accounting Problems ..... *Led by* E. C. Schwier
Customer-Employee Relationships ..... Charles W. Jones
Furnishing Water Service Beyond Corporate Limits:
- Extensions to Distribution Systems—Factors to Be Considered ..... F. R. Berry
- The Cost of Such Extensions in Northern Indiana ..... E. D. Anderson
- The Legal Liabilities Involved Under Indiana Law ..... Nathan Levy

Ozonation at Whiting, Indiana ..... James Bartuska

Is It Profitable and Practical to Have Accurate Meters Sensitive to Low Flows? LaVerne Trentlage
Discussion ..... H. W. Niemeyer
Fire and Water Service in Time of War ..... Norman J. Howard
The Waterway to Health ..... *A Motion Picture*

Kentucky-Tennessee Section—Scheduled Papers

Address of Welcome ..... *Mayor* Thos. L. Cummings
Address of Welcome ..... J. W. Bauman
Discussion of Report of A.W.W.A. Committee on Standards of Purification Plant Operation ..... W. H. Lovejoy
Relationship of River Dams to Community Waters Supplies ..... W. G. Stromquist and L. H. Clouser
Maintenance of Elevated Tanks and Standpipes ..... Chas. J. Leary
" " " " " " ..... H. F. Stearns
How to Make a Small Water Works Self-Sustaining ..... John M. Holladay
Problems and Limitations in the Extension of Water Service Beyond the City Limits ..... M. B. Whitaker
Priorities for Water Works Materials ..... G. S. Gillen
Water Works and National Defense ..... Thomas M. Niles
Address ..... Harry E. Jordan
A Comprehensive Survey of Large Meters in Nashville ..... R. L. Lawrence Jr. and Allan R. Sharp
Round Table Topics:
Shortage of Water
Stream Pollution and Water Supply
Licensing of Operators
Activities in Which the Section Should Engage

Michigan Section—Scheduled Papers

Address of Welcome ..... *Mayor* George W. Welsh
News of the Field ..... R. J. Faust
Michigan Council of Defense ..... V. H. White
Michigan on Guard ..... Harold Mulbar
Sanitation Problems in Defense Areas ..... Loring F. Beming
Meter Maintenance Practice ..... Arthur P. Kuranz
Discussion ..... Alfred Eckert
Water Rate Structures ..... W. Sears Herbert
Discussion ..... L. E. Ayres
Bacteriology ..... W. L. Mallmann
Chlorination ..... A. E. Griffin
Studies on the Accuracy of Threshold Odor Values ..... Roberts Hulbert and Douglas Feben
Address ..... Louis R. Howson
Discussion and Color Pictures of Grand Rapids' New Water Supply With History of Water Problem ..... Peter A. Kammeraad

Minnesota Section—Scheduled Papers

Address of Welcome ..... *Mayor* Marvin L. Kline
Response ..... A. C. Janzig
Brief History of the Minnesota State Section ..... H. A. Whittaker
Remarks ..... Lewis I. Birdsall and J. A. Jensen

History of the Water Supplies in the State of Minnesota.....Otto E. Brownell
Materials Used in Water Distribution Systems.....Harry Stock
Discussion.....Edgar W. Johnson, W. P. Tarbell and W. D. Hurst
Phenomenalistic Chlorination.....A. E. Griffin
Discussion.....J. J. Handy, Herbert S. Grove and Earl H. Ruble
Liabilities of Municipalities.....Orville C. Peterson
Practical Distribution System Design by the Hardy Cross Method.....
W. D. Hurst and N. S. Bubbis
Water Softening in Minneapolis.....Frank Raab
Discussion.....Ross A. Thuma and J. E. Young
Phosphate Treatment as a Means to Prevent Scale Formation..John D. Turner
Discussion.....M. H. Bischoff and Bernard Grodin
Water Works Accounting.....W. H. Sherman
Discussion.....John C. Flanagan and J. M. Pinkerton
Address.....Harry E. Jordan
Water Distribution System and Fire Pumpers.....A. M. Kircher
Discussion.....Sanford Herberg and W. Somero
Filters, Filter Material and Underdrains.....Arthur F. Mellen
Discussion.....L. N. Thompson and Wm. Yegen

Missouri Valley Section—Scheduled Papers

Round Table Discussion—Water Works and the National Defense Program
Greetings From Cedar Rapids.....*Mayor* F. K. Hahn
Response.....W. Scott Johnson
Greetings From the American Water Works Association.....Louis R. Howson
First Year's Operation of Wichita's New Well Water Supply.....M. E. Rogers
Personnel Relations in a Water Works Organization.....Harry S. Morgan
Your Water Department and Its Relation to City Finance.....Rhea Rees
Water Treatment Problems in South Dakota.....Everett R. Mathews
The Cedar Rapids Water Works.....H. F. Blomquist
Missouri River Navigation Improvements and Their Relation to Valley Properties.....F. S. Besson
Discussion.....William T. Bailey and A. H. Wieters
A New Water Softening Plant at Harper, Iowa.....D. W. Senges
The Use of Ferrisul as a Coagulant.....Roger C. Higgins
Kansas City's Water Softening Improvements.....Melvin P. Hatcher
The Maintenance of Water Works Pumps.....Vance C. Lischer

Montana Section—Scheduled Papers

Address of Welcome.....*Mayor* Dwight N. Mason
Address.....O. J. Ripple
Chairman's Address.....Kurt Wiel
Address.....W. F. Cogswell
Use of Calgon in Water Supplies.....F. F. Redman
Precipitation Trends in the Northwest.....D. I. Grush
Symposium on Organization for Emergencies and Civil Defense:
Personnel.....A. L. Hewett
Water Supply Structures.....Roy Arnold
Water Treatment Plants.....Ed Henen
Water Distribution Systems.....Dave Thomas
Emergency Supplies and Emergency Disinfection.....H. B. Foote
Comments on Defense.....John Hall
Some Aspects of the Denver Water System.....O. J. Ripple

Beautification of Water Works Grounds...Eugene Carroll and Wade Plummer
Address...W. P. Hughes
Round Table Session...*Led by* C. O. Lauer
Description of the Missoula City Water System...H. S. Thane

New Jersey Section—Scheduled Papers—Winter Meeting

Effects of Changing Population Trends on the Water Works Problem...Charles J. Alfke
Discussion...James E. Garratt and Reeves Newsom
Vagaries of Our Water Problem...George S. Burgess
Algae Control...William D. Monie
Discussion...Thurlow Nelson and Lee Purcell
Round Table—What Have You Planned or Done to Prepare Your Water Works for Wartime Conditions?

New Jersey Section—Scheduled Papers—Fall Meeting

The Latest on Priorities...Harry E. Jordan
Wholesale Water Works Accounting...M. M. McLaughlin
Discussion...James E. Garratt
Pumping Station Records and Cost Data...Herman Kohan
Discussion...Charles Bourgin
Post-War Plans for Water Works Construction...Abel Wolman
Elementary Hydraulics—Part IV...H. N. Lendall
Soliloquy—A Bit of Hydraulic Psychology and Common Sense...D. R. Taylor
Symposium and Round Table Discussion on Deep Wells...*Led by* J. C. Harding
Relationship Between the Well Drilling Contractor and the Owner...E. D. Every
Well Drilling Contracts—From an Engineer's Standpoint...E. A. Bell
Experiences in Developing Rock Wells...J. A. Carr
Progress Report and Discussions of Specifications for Deep Wells and Deep Well Turbine Pumps
Informal Round Table and Question Box...*Led by* E. P. Hyland and E. Vernon Smith

New York Section—Scheduled Papers—Spring Meeting

Address of Welcome...*Mayor* Rolland B. Marvin
Construction of a New Type of Reservoir for Syracuse...Elon P. Stewart
Auxiliary Water Supplies for Fire Protection...A. C. Hutson
Pollution of the Rochester Public Water Supply and Emergency Disinfection of the Distribution System...George W. Moore
Round Table—Practical Problems in the Elimination of Cross-Connections...*Led by* Hugh S. Dewey
Rapid Design and Construction of a Water Works System at Pine Camp...A. Bradford Squire
Some Current Water Treatment Difficulties...Thos. M. Riddick
Protective Lighting of Municipal Water Works...Robert J. Swackhamer
Round Table—National Defense in Public Water Supplies...*Led by* W. L. Malcolm

New York Section—Scheduled Papers—Fall Meeting

Address of Welcome...*Mayor* John Bazinet
A Dam Built on Sand...Ernest L. H. Meyer

The Effect of the Defense Program Upon Water Works Activities ..... Harry E. Jordan
National Defense at Gloversville ..... Robert M. Colt
Mutual Aid Plan for Water Service in New York State ..... Allan H. Rogers
Report of Committee on Group Meetings ..... William H. Clark
Round Table Discussion—National Defense ..... *Led by* Hugh S. Dewey
The Design and Construction of a Modern Water Collection and Transmission System ..... R. K. Patterson
The New Gloversville Filtration Plant ..... Morrell Vrooman
Billing Procedure Developed for a Group of Small Plants ..... W. H. Ogden
Civil Service Extension in New York State ..... Frank E. Densler
Round Table—A Review of Experiences ..... *Led by* R. G. Yaxley

North Carolina Section—Scheduled Papers

Address of Welcome ..... *Mayor* O. Arthur Kirkman
Response ..... A. O. True
The Stone Canyon Inlet-Outlet Line of the Bureau of Water Works and Supply of Los Angeles ..... *A Motion Picture*
Description of High Point Treatment Plants ..... Aubrey James Setzer
Cold Water Coagulation—Experiences at Durham, N. C. ..... J. R. Malone
Industrial Water Requirements ..... A. S. Behrman
Textile Industry ..... John L. Brown Jr.
Paper Industry ..... Henry Seaman
Bottling Industry ..... John M. Sharf
Round Table Discussion of Water Treatment Problems ..... *Led by* R. Frank Hill
Address ..... A. S. Bedell
Treatment of Sewage Using Intermittent Sand Filters ..... Robert H. Grady
Water—A Natural Resource ..... Guy R. Scott
Round Table Discussion of Sewage Treatment Problems ..... *Led by* W. M. Franklin
Address ..... Louis R. Howson
Legal Aspects of Sewage Treatment ..... Grover Jones
Maintenance of Elevated Water Storage Tanks ..... H. F. Stearns
Open Discussion of Procurement Situation ..... Harry E. Jordan

Ohio Section—Scheduled Papers

Opening Address ..... C. O. Sherrill
Water Supply of Cincinnati ..... C. A. Eberling and *Staff*
Progress on Toledo Water Works ..... O. E. Clark
Municipal and Suburban Water and Sewer Problems ..... J. A. Hickey
Water Supply and National Defense ..... F. H. Waring
Reforestation of Ohio Water Works Properties ..... T. R. Lathrop
Odd Collection Experiences ..... Lee Harvey and T. W. Morgan
Paint for Water Tanks ..... M. C. Kinder
Address of Welcome ..... *Mayor* James G. Stewart
Address ..... Louis R. Howson
Address ..... Harry E. Jordan
Ohio River Pollution Survey ..... Maurice LeBosquet
Round Table Discussions:
Thawing Water Services ..... *Led by* A. D. Claggette
Service Materials ..... *Led by* C. E. Inman
Hydrant Location ..... *Led by* Harry Seidenspinner
Lining Water Mains ..... *Led by* W. R. LaDue and R. W. Furman

Troubles With Joint Material.....*Led by* N. J. Humason
Manifold Meter Setting.....*Led by* A. S. Hibbs
Advantages of a Water Works Machine Shop.....*Led by* W. W. Morehouse
Tastes and Odors on Distribution Lines.....*Led by* J. S. Gettrust

Pacific Northwest Section—Scheduled Papers

Round Table Topics.....*Led by* Glen W. Campbell
Problems of a Small Town Water Superintendent.....P. D. Wilson
Pressure Gages and Their Use in the Distribution System....S. L. Benedict
Experience With Leak and Pipe Locators.....E. F. De Ford
Report of Committee on Meter Specifications and Discussion of Meter Problems in General.....Fred D. Jones
Report of Ground Water Committee.....Alex Lindsay
Water Supply and Its Relation to National Defense..Norman J. Howard
Report of the Committee on Short Schools and Licensing of Operators....Carl E. Green
Automatic Recording and Control Devices Used in the Tacoma Water System.W. A. Kunigk
Suburban Demands on Cities and Towns for Water Supply...C. C. Casad
Fundamentals of Corrosion.....Geo. W. Gleeson
Seattle Water System.....W. C. Morse
Report of Electrolysis and Grounding Committee.....F. Ford Northrop
Elimination of Political Influence in Water Works Management..M. B. Byron
Customer Relationship.....Wm. M. Van Liew
Does Your Water Supply Meet Accepted Bacteriological Standards?.....Carl E. Green
Report of Committee on Safe Practices.....Brian L. Shera

Rocky Mountain Section—Scheduled Papers

Address of Welcome.....Paul S. Fox
Legal Difficulties Encountered With the Santa Fe Sewage Disposal Plant..C. R. McIntosh
The Artesia, New Mexico, Sewage Treatment Plant..Charles N. Goldenberg
Panel Discussions:
Damage to Sewage Treatment Plants by Floods
Protection of Sewers and Treatment Plants Against Sabotage
Sewerage Facilities in Areas Adjacent to Cantonments
Utilization and Disposal of Sludge—Dried and Wet
Trends and New Ideas in Sewage Treatment
Miscellaneous Problems
Address of Welcome.....*Governor* John E. Miles
Response and Chairman's Address.....Wm. A. Peters
Sabotage of Public Water Supplies.....D. A. Bryce
Discussion.....Jack Davis, Ray C. Bollier and O. J. Ripple
Cathodic Protection of Water Mains.....Stuart W. Akins
Discussion.....D. D. Gross and Web Ballinger
Description of the Hatch, New Mexico, Water Supply..Charles N. Goldenberg
Well Water Supplies.....John McGowan
Discussion.....L. A. Mather, George Blizzard and Robt. Portman
Meters.....Jackson Brown
Discussion.....Truman L. Dennis
Masonry, Earth-Fill and Arch Dams.....Rufus Carter
Discussion.....George M. Neel

Water Superintendent's Relationship to Other Local Public Health Activities. Dudley Peters Glick
Discussion.....Paul S. Fox, L. O. Williams and B. V. Howe
State Aid to Municipal Utilities.....W. Carlos Powell
The Arch Hurley Conservancy District.....Harold Much
Panel Discussion on Water Purification.....
O. J. Ripple, Chester Truman, L. C. Osborn, Carl Bennet, Frank Hill, Dana Kepner, George Turre

Southeastern Section—Scheduled Papers

Santee-Cooper Dam.....L. F. Harza
Elevated Tank and Standpipe Maintenance.....
H. F. Stearns, John Perryman and C. D. Turner
Well Water Treatment.....H. M. Mathews, M. G. Stewart and F. K. Ellis
Welcome.....*Mayor* Henry W. Lockwood
Address.....C. P. Summerall
Reading of Gullah Stories.....Harold S. Reeves

Southwest Section—Scheduled Papers

Address of Welcome.....*Mayor* I. N. McCrary
Response.....A. M. Brenneke
Remarks.....S. H. Bothwell
The Fort Worth Water Works.....W. S. Mahlie
Water Supply Improvements for Oklahoma City.....M. B. Cunningham
Improvements in Water Supply During the Past Year:
Texas.....V. M. Ehlers
Oklahoma.....H. J. Darcy
Arkansas.....W. A. Reiman
Louisiana.....J. H. O'Neill
Water Supply for Army Camps.....Thomas M. Niles
Problems in Water Works Operation Resulting From the Defense Program.....
V. M. Ehlers
Water Filtration Plant Improvements at Wichita Falls.....D. B. Dickson
Licensing of Filter Plant Operators.....Edward R. Stapley
Evaluation Studies of Water Laboratories in Texas.....S. W. Bohls
Recommendation and Progress in Controlling Oil Field Pollution.....
B. F. Williams and J. C. Oliver
Corrosion of Water.....L. C. Billings
Address.....John H. Anderson
Municipal Versus Private Water Plants Ownership.....Joe J. Rady
Central Billing and Bookkeeping for a Group of Plants.....D. W. Robinson
Bad Debts Records and Collections.....G. A. Marbach
Cost Accounting for Water Works.....Z. Turner McGuire
Machine Billing.....Joe J. Murray
Meters and Meter Reading.....W. F. McMurray
Public Relations.....Ashley Classen
Address.....Louis R. Howson
Operation and Maintenance of Water Works Pumping Equipment.....
Thos. L. Amiss
Cast-Iron Pipe.....Tom Hanlon Jr.
Water Main Cleaning.....Walter F. Hicks
Cast-Iron Pipe.....Wes Westmoreland
Municipal Water Works Valuation.....A. P. Learned

Priority as to Water Works Material and Equipment.....Homer A. Hunter
Water Boards Administration Versus Municipal Administration.....
Henry Nunn

Virginia Section—Scheduled Papers

Review of the Toronto Convention.....R. C. Bardwell
The James River Project of the Virginia Academy of Science.....
Marcellus H. Stow
Water Supply for Chesterfield County.....Stuart Royer
Super-Chlorination.....A. E. Griffin
Defense of Water Supplies for the Army and the General Public.....
W. A. Hardenberg
The American Water Works Committee on Defense.....E. F. Dugger
Magic.....H. Lloyd Nelson
Cast-Iron Pipe.....*A Motion Picture*
Study of the Ultra-Violet Fluorescence in Laboratory Problems.....
C. L. Crockett
Removal of Iron From Small Water Supplies.....H. E. Lordley
Cleaning Water Lines.....Chas. W. Davis
Water Plant at Norton, Va.....W. P. Canto
Steel Filter Plant Installation at Richlands.....I. T. Jessee
Experience With Water Supply for Washington County Sanitary District.....
J. B. Vance
The American Water Works Association.....Louis R. Howson
Sterilization of Water Mains.....W. H. Shewbridge
How Chemical Manufacturers Can Render Service to Small Water Works.....
Chris. F. Bingham
Principles of Cathodic Tank Protection.....A. B. MacTaggart
Question Box.....Richard Messer

West Virginia Section—Scheduled Papers

Address of Welcome.....C. E. Lawall
Landscape Treatment of Water Plant Grounds.....C. E. Dill
Water Safety.....Jack J. Hinman Jr.
Water Softening at Lochgelly.....H. Y. Keeler
Sewage Treatment Plants in West Virginia (*A Motion Picture*).R. G. McCall
Unusual Engineering Features of an Iron Removal Plant.....H. P. Musser
Depletion of Underground Water a National Menace.....C. F. McClintic
Underground Water Survey in West Virginia...Paul H. Price and R. L. Nace
Water Works Operation Under Emergency Conditions...Harry E. Jordan
Improvement in Industrial Effluents in the Charleston Area...K. S. Watson
Application and Control of Break-Point Chlorination in a Small Water Plant.
R. C. Clement
Experiences With Break-Point Chlorination:
Wheeling.....A. R. Todd
Charleston.....P. L. McLaughlin
Weston.....Lawson Haynes
Bacteriological Examination of Water at the State Hygienic Laboratory
(*Paper and Motion Picture*).....(*Miss*) K. E. Cox
Combating Phenol Wastes at Williamson, West Virginia.....Frank Offutt
Discussion.....H. F. Laughlin
Measurement of Water.....H. W. Speiden

Plant Improvement at Weirton.....Paul D. Simmons
Plant Improvement at Fairmont...Bernard G. Sampson and Wm. Kirchman
Developments in the Application of Sodium Hexametaphosphate.....
J. P. Kleber

Western Pennsylvania Section—Scheduled Papers

Address of Welcome.....*Mayor* Charles R. Barber
Industrial Stream Pollution Problems and Their Solution..Richard D. Hoak
Symposium on Cleaning and Lining of Water Mains:
Water Main Cleaning.....Clinton Inglee
Cleaning and Lining With Bitumastic Enamel.....J. M. Kamps
Cement Lining in Position.....Bruce Harkness
Cement Lining.....H. Seaver Jones
Flood Control Reservoirs on Pennsylvania Rivers.....D. D. Rait
Laboratory Control of Water Treatment.....W. U. C. Baton
Water Conditioning by Flocculation.....S. L. Tolman
Protective Measures for Civil Defense in the Event of a Major Emergency..
J. E. Thornton
Policy of Municipal Rate Making.....Joseph A. Beck
Remarks.....Louis R. Howson
Remarks.....Harry E. Jordan
Iron Removal in Western Pennsylvania Water Supplies.....
L. S. Morgan and C. H. Young
City of Erie Water System.....James S. Dunwoody
Machinery Breakdown Insurance for Water Works.....A. F. Graham
Paper Mill Waters, Conservation, Use and Improvements in Waste Discharges.
Joseph P. Gray
Symposium on Filter Beds:
The Filter Bed and Its Care.....George Papesch
Filter Bottoms.....J. P. Myron
Filter Media.....R. B. Adams
Discussion.....*Led by* B. French Johnson

Wisconsin Section—Scheduled Papers

Greetings From the City of Racine.....*Mayor* T. Gleason Morris
Opening Remarks.....James W. Myers Jr.
Policy of Water Main Extensions in Both Urban and Suburban Districts....
Preston A. Reynolds
Mobile Equipment for Water Departments.....Frank K. Quimby
Civilian Protection in Wartime in Sanitary and Public Health Engineering..
Samuel A. Greeley
Depreciation as It Affects Water Works Plants.....A. R. Colbert
Corrosion of Copper and Lead Services.....M. Starr Nichols
Corrosion Study of Bolting Materials and Coatings.....Otto Halverson
The Planning and Operating of Elevated Storage Tanks..Joseph P. Schwada
Improvements and Extensions, Including Softening Equipment at Appleton
Wm. U. Gallaher
Actual Experiences in Laying Water Mains.....Herbert Ihling
Procedure in Repairing Water Main Breaks.....Rheinhold Klebenow
New Elevated Tank at Madison.....L. A. Smith
Priorities.....Harry E. Jordan
Special Problems of Suburban Water Service.....George Prindle

Experiences in Operation of Milwaukee Filter Plant ..... James Kerslake
Better Water Quality Standards for Inspiring Better Water Purification Plant Operation ..... John R. Baylis
Discussion of Standards of Purification Plant Operation ..... James Kerslake and Harry E. Jordan
Discussion of Proposed New Standard of Water Analysis ..... Bernard Domogalla and M. Starr Nichols
Reclaiming Capacity of Wells ..... E. D. Brown
Restoration of Well Yield by Acid Treatment ..... John Barth
Discussion on Maintenance of Screened Wells ..... Walter Staeffler
Development of Rock Wells by Shooting ..... Ralph E. Milaeger
Discussion ..... A. P. Kuranz
Proposed A. W. W. A. Standard Specifications:
Deep Wells ..... O. J. Muegge
Deep Well Pumps ..... L. A. Smith

Section Meetings—1941

Section	*Meeting Place*	*Date*
California	Fresno, Calif.	Oct. 22–24
Canadian	Toronto, Ont.*	June 23
Cuban	No scheduled meeting	—
Florida	Daytona Beach, Fla.	Nov. 13–15
Four States	Baltimore, Md.	Nov. 5–7
Illinois	Quincy, Ill.	Apr. 28–30
Indiana	Indianapolis, Ind.	Apr. 24–25
Kentucky-Tennessee	Nashville, Tenn.	Oct. 27–29
Michigan	Grand Rapids, Mich.	Sept. 24–26
Minnesota	Minneapolis, Minn.	Oct. 9–11
Missouri Valley	Cedar Rapids, Iowa	Oct. 20–22
Montana	Missoula, Mont.	May 23–24
New England	No scheduled meeting	—
New Jersey	New Brunswick, N. J.	Feb. 19
	Florence, N. J.	May 22
	Atlantic City, N. J.	Oct. 16–18
New York	Syracuse, N. Y.	Mar. 27–28
	Glens Falls, N. Y.	Sept. 11–12
	New York, N. Y.	Dec. 30
North Carolina	High Point, N. C.	Nov. 3–5
Ohio	Cincinnati, Ohio	May 15–16
Pacific Northwest	Seattle, Wash.	May 8–10
Rocky Mountain	Santa Fe, N. M.	Sept. 17–19
Southeastern	Charleston, S. C.	May 12–14
Southwest	Fort Worth, Tex.	Oct. 13–16
Virginia	Roanoke, Va.	Oct. 30–31
West Virginia	Morgantown, W. Va.	Oct. 30–Nov. 1
Western Pennsylvania	Erie, Pa.	Aug. 7–9
Wisconsin	Racine, Wis.	Oct. 6–9

* Business meeting only—held at Annual Convention.

Section Membership at Time of, and Total Attendance at, Section Meetings—1938–41

SECTION	1938		1939		1940		1941	
	Membership	Attendance	Membership	Attendance	Membership	Attendance	Membership	Attendance
California	440	1,007	470	1,035	501	1,082	552	688
Canadian	217	415	222	445	219	367	262	*
Cuban	†	—	†	—	27	‡	35	‡
Florida	52	82	63	110	76	134	78	110
Four States	174	129	191	150	186	177	210	177
Illinois	181	184	194	§	199	226	197	152
Indiana	104	195	125	230	125	200	142	223
Kentucky-Tenn.	63	152	74	108	89	93	105	91
Michigan	88	192	99	218	116	233	124	245
Minnesota	48	156	69	115	77	169	86	144
Missouri Valley	146	208	175	*	197	150	199	153
Montana	35	68	36	118	41	75	42	66
New England	127	‡	131	‡	137	‡	139	‡
New Jersey‖	174	150	205	136	218	172	221	134
New York‖	461	§	438	190	440	206	472	171
North Carolina	78	240	90	244	108	226	113	243
Ohio	†	—	139	136	163	198	173	118
Pac. Northwest	112	232	121	224	141	260	165	262
Rocky Mountain	74	95	79	131	87	123	88	84
Southeastern	134	*	143	222	157	222	166	192
Southwest	121	300	121	422	202	297	167	391
Virginia	49	100	53	94	53	103	68	153
West Virginia	†	—	54	145	63	168	65	125
Western Penna.	†	—	106	73	120	142	132	135
Wisconsin	72	233	73	258	76	238	89	237

* Regular meeting canceled. Business meeting held at Annual Convention.

† Section not organized.

‡ No regular meeting scheduled. Membership given as of date of Annual Convention.

§ No record of attendance.

‖ Three regular meetings held. Only Fall meeting recorded here.

Subject Index

A

Accounting; *see also* Financing, Records
commercial department; costs of, in U. S. cities, 1373
procedure for, for a group of small plants, 2201
depreciation; statement on, to A.W.W.A. directors, 359
methods of, in Denver municipal water works, 1648
Activated carbon; *see* Carbon
Administration; *see also* Management
joint water and sewer account; report on, 1911
sewerage system; new problems in, 1912
Advertising; *see* Public relations
Aeration; coke contact; combination of, with sand filtration for iron removal, 1935
loss of chloramine residuals in, 2097
taste and odor control by, 2125
Agitator; surface; *see* Filters
Air gaps; protection of cross-connections and inter-connections by, 441
standards for, 1572
Akron, Ohio; cement-mortar lining of water mains at, 1671, 1698
Algae; control of, in impounding reservoirs, 705
difficulties with, in filters, prevention of, by surface wash, 1230
flagellated; two groups of, as indicators of clean water, 1099
plankton; control of, by copper, chlorine and ammonia, 2108
American Gas Association; opinion of, on special rates to federal housing projects, 1641
American Standards Association; organization, purpose and functions of, 1584
plumbing standardization work of, 1571
Sectional Committee A-40; organization and membership of, 1579
American Water Works Association; audit of association funds for 1940, report of, 774
Board of Directors: action of, on Water Works Practice Committee report, 363
committee reports; chlorine-ammonia treatment of water, 2079
joint administration and collection of water and sewer accounts, 1911
joint research on boiler feed water studies, 1402
methods of determining fluorides, 1965, 2079
specifications for filtering materials, 2021
water conditioning methods to inhibit corrosion, 1534
water treatment and laboratory control, 2051
water works practice, 343
committees; Steel Pipe Manufacturers Technical Advisory; rules and regulations of, 1719
Steel Plate Pipe; current activities of, 1716
Convention—1941, report of, 2227
Indiana Section Technical Committee; Sub-Committee on Emergencies; progress report of, 1079
Sub-Committee on Meter Settings; report of, 1666
membership statement for, for 1940, 778
publications of, list of, *a section of the December issue*
relation of, to public relations problem, 93
section meetings—1941, report of, 2237
specifications; tentative; for cold water meters—displacement type, *a section of the December issue*
for sluice gates, *immediately following page 1860*
staff report; licensing and certification of water works operators, by states, 631

Ammonia; *see also* Chloramines
nitrogen; determination of, 2113
natural; relationship of, to formation of chloramines, 2095
plankton control by, 2108
residual; in distribution systems, 2095
sources of; comparative value of, for formation of chloramines, 2095
Ammonia-chlorine treatment; *see* Chloramination
Analysis; *see also* Quality
ammonia nitrogen, 2113
bacteriological; relative value of 2- and 5-per cent brilliant green bile and lactose broth media in, 649
size of test portions in, 1242, 1804, 2217
dissolved oxygen; nomograph for, 1111
drinking water; Treasury standard requirements in, proposed changes in, 1806, 2215
flow; *see* Hydraulics
fluorides; *see* Fluorides
metal concentration; polarographic method of, 1544
nitrates; by modification of the phenoldisulfonic acid method, 1589
nitrite nitrogen, 2115
residual chlorine; equipment for, availability of, for emergency use, 1325
methods of, 2112
photo-electric colorimeter for use in, 659
solids; in water softening sludges, 747
sulfide; in low concentrations, 943
water; sampling methods for, in Venezuela, 281
zinc; rapid; in water supplies, 246
Annexation; application of, to water supply problems in metropolitan areas, 1876
Anodes; cathodic protection; types of, 1508
Appalachian Electric Power Co.; decision of Supreme Court against, on navigability of New River, 315
Aqueducts; *see* Pipe, Transmission systems
Arthurdale, W. Va.; control of iron bacteria by super-chlorination at, 168
Asbestos rope; use of, in jointing mains, 772
Automotive equipment; operation and maintenance costs of, in U. S. and Canadian cities, 1362
Auxiliary facilities; *see* Distribution systems, Supplies

B

Back-flow; preventers; standards for, 1574
protection against; legal aspects of, 495
practical aspects of, 391
Back-siphonage; *see* Back-flow
Bacteria; coliform; relationship of, to gastro-enteritis, 1430
testing for, size of portions in, 1242
use of 2- and 5-per cent brilliant green bile media in analysis for, 649
destruction of, by chloramines, 2098
gastro-enteritis-carrying; isolation of, 1430
iron; control of, by super-chlorination, 168
Bacterial corrosion; *see* Corrosion
Bacteriology; *see* Analysis
Baltimore; metropolitan district of, development of, 1880
Billing; costs of, in U. S. cities, 1373
joint water and sewer account, 1919
methods of, at Cincinnati, 1214
procedure for, for a group of small plants, 2201
sewer account; procedure of, in special cases, 1921
Birm; iron and manganese removal with, 1933
Boilers; feed water for, *see* Feed water
insurance of; inspection service and types of coverage offered for, 2192
Bonds; *see* Financing
Break-point chlorination; *see* Chlorination
Brilliant green bile; *see* Media
Brine; reclamation of, after use for zeolite regeneration, 271
regeneration of synthetic zeolites with, 267
Britain; defense of utility services in, 1440
pollution prevention in distribution system in, 1116
Buffalo, N. Y.; pumping station at, protection of, against service interruptions, 1586

C

Calcination; sludge; lime recovery by, 741
Calcium; carbonate; deposition of, in distribution systems, effect of sodium hexametaphosphate on, 1239
hypochlorite; availability of, for emergency use, 1322
Calgon; *see* Sodium hexametaphosphate
California; Southern; mutual water companies in, problems of, 894
Calking; *see* Pipe, joints in
Canada; automotive equipment in, control of, 1364
civil service in, 1609
meter maintenance practice in, 1381
water rate structures in, 1389
water supplies of, investigation of, 967
Carbon; activated; evaluation of, accuracy of threshold odor method of, 1945
taste and odor control by, 2132, 2140
Cathodic protection; experimental failure of, as protection against bacterial corrosion, 156
history of, 1503
tank; cost of, 1514
experiences with, 1503
ice problem in, 1508
theory and practice of, 305
Caustic soda; feeding of, for pH correction, 288
Cement; gunite; construction of storage reservoir with, 863
lining with; *see* Linings
pipe jointing with, 769
Certification; *see* Personnel
Charcoal filters; *see* Filters
Chemical feeders; availability of, for emergency use, 1323, 1327
chlorinators; portable; design and use of, 1328
Chemistry; *see* Analysis
Chloramination; committee report on, 2079
effect of, on pipe line capacity, 2102, 2103
laboratory determinations relating to, 2112
literature on, review of, 2080, 2121
reduction of pipe friction losses by, 2103
use of, extent of, 2085
Chloramine; bactericidal value of, 2098
formation of; comparative value of various sources of ammonia for, 2095
conditions affecting, 2095
relationship of, to natural ammonia nitrogen, 2095
plankton control by, 2108
residual; differential test for, 2115
in distribution systems, 2095
loss of, in aeration, 2097
sterilization by, 2133
taste and odor control by, 2097, 2134, 2137
Chlorination; *see also* Chloramination, Sterilization
break-point; inapplicability of, to some waters, 251
de-; use of sulfur dioxide for, at Richmond, Va., 253
emergency; application of, in disinfecting accidentally polluted water supply at Rochester, N. Y., 1339
equipment for; types of, available for emergencies, 1319, 1327, 1344
pre-; benefits of, and problems in, 250
preparation of water for filtration by, 249
super-; control of iron bacteria by, 168
taste and odor control by, 2131, 2135
taste and odor problems introduced by, 2130
Chlorinators; *see* Chemical feeders
Chlorine; *see also* Chloramine
availability of, for emergency use, 1321
effectiveness of, in destruction of cysts of *Endameba histolytica*, 1710
plankton control by, 2108
residual; determination of, photoelectric method for, 659
differential test for, 2115
Chlorine-ammonia treatment; *see* Chloramination
Chrysophyceae; as indicators of clean water, 1104
Cincinnati; cement-mortar lining of large cast-iron main at, 1693
water supply of, 1199
Civil service; adequate; values of, 1591
experiences with, in Canada, 1609
limitations of, 1596
Cleveland; sewer rental experiences in, 1923
Coagulation; effect on, of turbidity, 911
experiments on, at Wichita, 1235

pre-chlorination as an aid to, 250
Coatings; *see also* Linings
bituminous; mechanical application of, 1723
spun; equipment used for, 1746
steel pipe; specifications for, list of, prepared by Committee 7A, 1716
tank; materials for, experimental studies on, 1553
Codes; plumbing; standardization of, 1577
Coefficients; *see* Hydraulics
Coliform organisms; *see* Bacteria
Collection; *see also* Billing
delinquent account; effect of joint water and sewer account administration on, 1921
practices of, in U. S. cities, 1373
legal measures for, at Cincinnati, 1215
joint water and sewer account, report on, 1911
Colorado River; softened water of, use of, for home gardens, 883
Committee reports; *see* American Water Works Association
Communication; radio; use of, in emergencies, 1166
telephone; defense of, in Britain, 1446
Conditioning; *see* Treatment
Conduits; *see* Pipe, Transmission systems
Conferences; *see* Short schools
Connecticut; utility co-ordination for defense in, 1083
Conservation; *see* Erosion, Reforestation
Construction projects; program for, as a factor in good management, 1162
temporary; civil service in, limitations of, 1597
Contamination; *see also* Pollution
bacterial and poison gas; methods of combating, in Britain, 1443
Control; automatic; application of, to ozonation equipment, 2043
devices for, in Tacoma, Wash., 1188
use of, at Toronto's new plants, 1018
laboratory; adequacy of present methods of, 2051
standarization of, difficulty of, 1815
well supply; methods of, at Wichita, 1234
Copper sulfate; *see* Treatment
Corrosion; *see also* Cathodic protection, Coatings, Linings, Painting
bacterial; iron and steel affected by, 147
control of; at Orange, Va., 299
at Richardton, N. D., 293
by pH correction, 286
studies in, 1409
current problems in, 903
fundamentals of, 1249
inhibition of; by painting, 309
water conditioning methods for, committee report on, 1534
lead; inhibition of, with sodium hexametaphosphate, 1179
nature and mechanism of, 302
Couplings; sleeve type; emergency distribution system repairs with, 1790
Crenothrix; control of, by super-chlorination, 168
Creston, Iowa; failure and rehabilitation of water supply of, 953
Cross-connections; pollution of water supply through, at Rochester, N. Y., 1334
prevention of, 1572
protection of; legal aspects of, 495
practical aspects of, 391
Cryptophyceae; as indicators of clean water, 1100
Customer relations; *see* Public relations

D

De-chlorination; *see* Chlorination
Defense; *see also* Emergencies, Priorities
civil; limitations of, 1479
local council for, at Gloversville, N. Y., 1869
organization for, 130
relation of individual to, 1307
rôle of public water supply in, 121
utility co-ordination for, 1079
utility service; experiences in, in Britain, 1440
water works; auxiliary supply for, in Westchester County, N. Y., 680
county health departments in, 702
FBI activity in, 1861
information on, *immediately following Abstract Section in July, August, September and November issues*
inter-connection of transmission systems for, in New Jersey, 1523

methods of, in New Jersey, 1517
pollution prevention in distribution systems after air raid damage, in Britain, 1117
problems of, 1475
protection of New York City water system in, 689
protective lighting in, 671
sabotage prevention in, 123
special considerations in, 1866
Delinquency; *see* Collection
Denver, Colo.; policy on special rates and free water in, 1634
water works finance and accounting methods at, 1648
Depreciation; *see* Accounting
Des Moines, Iowa; group insurance in, 1496
policy on special rates and free water in, 1635
Detroit, Mich.; joint administration of water and sewer accounts in, 1917, 1926
Disease; amebic dysentery; causative organism of, viability and destruction of, 1705
gastro-enteritis; epidemic of, in a large office group, 1263
isolation of causative organisms of, 1430
water-borne; incidence of, in U. S. and Canada in 1940, data on, 2051
Disinfection; *see* Chlorination, Mains, Sterilization
Dissolved oxygen; *see* Oxygen
Distribution systems; *see also* Mains, Pipes, Services, Tanks, Valves
ammonia residual in, 2095
automatic controls in, at Syracuse, N. Y., 873
auxiliary; design of, for emergency service and defense, 680
provision of, for fire protection, 972
back-flow and back-siphonage through cross-connection and inter-connections in, 391, 495
calcium carbonate deposition in, inhibition of, with sodium hexametaphosphate, 1239
cathodic protection of, *see* Cathodic protection
control in, *see* Control
corrosion in, *see* Corrosion
defense measures in, *see* Defense
developments in, during past 25 years, 732
effect of changes in treatment on, 1536
effect of sodium hexametaphosphate on, 1537
elevation of, relation of meter rates to, 1655
emergency repairs to, equipment available for, 1779
extensions to; costs of, 749, 1053
effect of population trends on, 827
financing of, 219, 1041
regulation of, in New York and New Jersey, 1048
survey of policies on, in U. S., 1357
features of, at Cincinnati, 1210
flow analysis in, *see* Hydraulics
improvements to, in Creston, Iowa, 959
insurance requirements for, 1058
maintenance of, *see* Maintenance
pollution in; prevention of, in Britain, 1116
through cross-connection with fire system, at Rochester, N. Y., 1334
pressure in, increase of, by additional storage, 861
protection of, for New York City, 689
underground structures in, cathodic protection of, 305
Districts; metropolitan; application of, to water supply problems in metropolitan areas, 1886
utility; management problems of, 1897
Dual systems; *see* Cross-connections
Duluth, Minn.; policy on special rates and free water in, 1630
Duplicate facilities; *see* Distribution systems, Supplies
Dysentery; *see* Disease

E

East Bay Municipal Utility District; development of, 1894, 1897
management problems of, 1897
pipe laying costs of, 749
Edison Electric Institute; opinion of, on special rates to federal housing projects, 1642
Electric utilities; defense of, in Britain, 1446

Electricity; *see* Power
Electrolysis; fundamentals of, 1259
leaks caused by; combating of, with cement-mortar lining at Akron, Ohio, 1671, 1698
Elevation; relation of meter rates to, 1655
Elk River; pollution survey of, 1093
Embankments; earth; lining of, with road oil, for storage reservoirs, 876
Emergencies; *see also* Defense
chlorination equipment available for use in, 1319, 1327, 1344
distribution system repair in, equipment available for, 1779
use of radio communication in, 1166
Enamel; coal-tar; *see* Coatings, Linings
Endameba histolytica; cysts of, viability and destruction of, 1705
Erosion; control of, to prevent silting in reservoirs, 1035
Experimental work; *see* Research work
Extensions; *see* Distribution systems

F

FBI; *see* U. S. Federal Bureau of Investigation
F.C.C.; *see* U. S. Federal Communications Commission
Federal control; *see* Regulation
Feed water; studies on, by joint research committee, 1402
Filters; charcoal; taste and odor control by, 2125
gravel for; methods of handling, at Indianapolis, 1221
maintenance and operation of, at Wichita, 1238
materials for; abstracts of studies on, 2025
specifications for, progress in preparation of, 2021
rapid sand; clogging of, 926
sand for; methods of handling, at Indianapolis, 1221
testing of, 2023, 2025
washing of; methods for, 1221
surface agitator for, at Indianapolis, 1228
Filtration; combination of, with lime treatment, for iron and manganese removal, 1939
equipment for, at new Toronto plant, 1014
methods of, used in West Virginia, 948
new plant for, at Cincinnati, 1206
sand; combination of, with coke contact aeration for iron removal, 1935
surface water; bacterial quality of water from small plants using, 913
Financing; extensions; methods of, in U. S. cities, 219, 1041, 1357
investment; increase of, by extensions to distribution systems, 1044
methods of; in Denver municipal water works, 1648
in East Bay Municipal Utility District, 1899
in Madison, Wis., 101
relation of, to meter rates, 1661
water revenue bond; effect of free water on, 1635
Fire hydrants; *see* Hydrants
Fire protection; auxiliary supplies for, 972
charges for; *see also* Rates
in Canada, 1395
consideration of, in insurance schedules, 1058
Fire trucks; use of, in emergency disinfection, at Rochester, N. Y., 1344
Fittings; steel pipe; hydrostatic testing of, 1761
standard types of, 1753
Flanges; steel pipe; standards for, 1753
Floc; effect of size of, on clogging of rapid sand filters, 930
Flocculation; current problems in, 908
Floodlighting; use of, in defense of water works property, 671
Floods; control of, on Willamette River, through Army Engineer project, 721
forecasting of; organization of service for, in Pennsylvania, 213
progress in, during past 25 years, 734
Flow; analysis of, *see* Hydraulics
distribution system; control of, by automatic devices, 1193
Fluorides; determination of; acetylacetone method, using the photronic colorimeter, 1981
correction for interfering ions in, 2210
distillation and titration methods for, 1975

ferric thiocyanate method for, 1979
methods of, 1965
modification of standard method for, 1971, 1973, 1974, 1975, 1982, 2018, 2210
Flushers; street; use of, in emergency disinfection at Rochester, N. Y., 1344
Forecasting; flood; *see* Floods
Fort Dodge, Iowa; policy on special rates and free water in, 1631
Free water; *see* Rates, special
Friction; pipe; capacity loss from, reduction of, by chlorine-ammonia treatment, 2103
Frontage charges; use of, for financing extensions in Los Angeles, 221
Funds; *see also* Financing
allocation of, Wisconsin law on, 98
surplus; use of, in Canada, 1399

G

Gages; recording; automatic; use of, in Tacoma, Wash., 1195
Gardens; *see* Irrigation
Gas; poison; contamination by, methods of combating, in Britain, 1443
utilities; defense of, in Britain, 1444
opinion of, on special rates to federal housing projects, 1641
Gastro-enteritis; *see* Disease
Gates; sluice; *see* Sluice gates
Geology; consideration of, in preparing well drilling code, 140
ground water; in the Houston area, 1768
Germicidal efficiency; of chloramine, 2098
Gloversville, N. Y.; national defense council at, 1869
Golden Gate Exposition; *see* Treasure Island
Government control; *see* Regulation
Grading; lowering cast-iron mains under pressure in, 764
water quality; application of, to drinking water standards, 1827, 2215
schedules for, need for, in Canada, 1400
Gravel; *see* Filters
Greenville, S. C.; policy on special rates and free water in, 1631
Ground water; *see also* Wells
iron in, in Western Pennsylvania, 1929
use of, to supply Houston, Tex., 1769
Grounding; electric; effect of, on water pipes, program for research on, 1541
Gunite; *see* Cement

H

Hardness; relative values of, of Canadian water supplies, 967
Hardy Cross method; *see* Hydraulics
Head loss; *see* Hydraulics
Health; *see also* Disease
benefits to, from control of well drilling, 138
departments; county; rôle of, in defense of water supplies, 702
protection of, through cross-connection, inter-connection and backflow control, 391, 495
Hexametaphosphate; *see* Sodium hexametaphosphate
Highland Park, Mich.; corrosion control by pH correction at, 286
Hobart, Ind.; costs of extensions to distribution systems beyond corporate limits in, 1053
Housing; *see* U. S. Housing Authority
Houston, Tex.; water supply of, development of, 1768
Hydrants; spacing of, insurance requirements for, 1067
Hydraulics; coefficients; comparison of, 75
trends in application of, to large pipe lines, 1
flow analysis; computation of equivalent lengths of parallel pipe systems in, 237
Hardy Cross method of; application of, to distribution system problems, 224
modifications to, 234
results of, on cement-mortar-lined mains, 1687, 1694, 1699, 1703
formulas; comparison of, 60
Mills; diagram and table for use of, 76
modernization of, 3
pipe line; history of, 1
Hydrographs; unit; flood forecasting in Pennsylvania by, 215
Hypochlorite; *see* Calcium, Chlorination

SUBJECTS

I

Ice; difficulties with, in cathodic protection of tanks, 1508
Indiana; district and short schools in, 618
Section; *see* American Water Works Association
utility co-ordination for defense in, 1079
Indianapolis; annexation practice in, 1893
methods of handling sand and gravel at, 1221
plankton control methods at, 2108
water works motion pictures in, 208
Inspection; insurance; value of, in maintenance of service, 2192
Insurance; machinery; inspection service and types of coverage offered for, 2192
Inter-connections; plumbing; prevention of, 1572
protection of; legal aspects of, 495
practical aspects of, 391
transmission system; development of, as a defense measure, in New Jersey, 1523
Investment; *see* Financing
Iowa; group insurance practices in, 1496
Iron; *see also* Pipe, Services, Mains
bacterial corrosion of, 147
removal of; *see also* Softening
in Western Pennsylvania water supplies, 1929
Irrigation; benefits to, of Willamette Valley Project, 721
effect of, on soil solution, 885
gardens; use of softened Colorado River water for, 883
water for; effect of salinity in, 885
furnished by mutual water companies, in Southern California, 894

J

Joints; *see* Pipe

K

Kanawha River; pollution survey of, 1087
Kentucky; electric power for water pumping plants in, 844

L

Laboratory; control; adequacy of present methods of, 2051
equipment; depth sampler; design of, 2207
mobile; design of, for use of Ohio River Pollution Survey, 636
design of, for use of Oregon State Board of Health, 644
technic; standards for, revision of, objections to, 1813, 2215
water analysis; organization of, by state in Venezuela, 277
Lactose broth; *see* Media
Law; application of; to collections, at Cincinnati, 1215
to cross-connection, inter-connection and back-flow protection, 495
to special utility rates, 1644
civil service; need for flexibility in, 1604
group insurance; present status of, in Iowa, 1496
social security; application of, to water works employees, 1489
Laying; *see* Pipe
Lead; *see also* Pipe, Services
pick-up of, in services, inhibition of, by sodium hexametaphosphate, 1179
solution of, by metaphosphates, 1538
Leaks; prevention of, caused by electrolytic action, with cement-mortar lining at Akron, Ohio, 1671, 1698
Legislation; *see* Law
Liability; *see* Law
Licensing; *see* Personnel
Lighting; protective; use of, in defense of water works property, 671
Lime; recovery of, from sludges produced in softening, 741
treatment with, combination of, with filtration, for iron and manganese removal, 1939
Linings; *see also* Coatings
bituminous enamel; effect of, on pipe line coefficients, 13, 55
mechanical application of, 1723, 1763
spun; equipment used for, 1733, 1763
cement; development of, 1695
cement-mortar; centrifugal method; application of, 1697, 1702

specifications for, 1690
use of, on large cast-iron main at Cincinnati, 1693
use of, on steel force mains at Akron, Ohio, 1671
use of, on steel trunk mains at Toledo, Ohio, 1682
Tate process; application of, 1697, 1702
concrete; effect of, on pipe line coefficients, 16, 55
Little Rock, Ark.; reduction of pipe friction losses with chloramine treatment at, 2103
Los Angeles; cement jointing in distribution system of, 769
civil service in, limitations of, 1596
defense organization in, 131
emergency radio communication in, 1173
financing of extensions in, 219
soils of, effect of irrigation on, 888
special rates and free water in, policy on, 1636
Louisville, Ky.; special rates and free water in, policy on, 1629

M

Machinery; insurance of, inspection service and types of coverage offered for, 2192
Madison, Wis.; effective management in, under municipal ownership, 99
Mains; *see also* Distribution systems, Pipes, Services
carrying capacity of, maintenance of, ineffectiveness of cleaning for, 1700
cast-iron; lowering of, under pressure, 764
cleaning of; in preparation for cement-mortar lining, 1675, 1682, 1693
in preparation for lining with coal-tar enamel, 1764
ineffectiveness of, in maintaining carrying capacities, 1700
restoration of capacity by, at Manasquan, N. J., 755
coating of, *see* Coatings
connection of; temporary; in emergency repairs, 1786
couplings for; sleeve type; use of, in emergency repairs, 1790
disinfection of; importance of, after repairs, 771
fractured; experiences with, in Britain, 1442
lining of; *see* Linings
Maintenance; automotive equipment for, costs of, 1362
department; accounting practices of, in Denver, 1651
distribution system; emergency; equipment available for, 1779
pollution prevention in, after air raid damage, in Britain, 1117
program for, at Cincinnati, 1211
meter; practices of, in U. S. and Canadian cities, 1381
problems of, in defense, 693
Management; *see also* Administration, Public relations
effectiveness of, under municipal ownership, 97
efficiency in, effect of relations of superintendent and elected official on, 84
factors in, 1161
mutual water company; problems of, 894
utility district; problems of, 1897
Manasquan, N. J.; cleaning of mains at, 755
Manganese; removal of, from Pennsylvania water supplies, 1931
zeolite; iron and manganese removal with, 1937
Media; brilliant green bile and lactose broth; comparison of, 649
Metals; comparative corrosive attacks on, by various waters, 1409
concentration of, analysis of, polarographic method for, 1544
protection of, by painting, 309
Metaphosphate; *see* Sodium hexametaphosphate
Metering; program for, at Scottsburg, Ind., 1218
Meters; cold water; displacement type; tentative specifications for, *a section of the December issue*
maintenance of, practices in, in U. S. and Canadian cities, 1381
rates based on; *see* Rates
reading of; costs of, in U. S. cities, 1373
procedure of, for a group of small plants, 2201
settings for; outside and inside; comparison of, 1666

SUBJECT

testing of; practices in, in U. S. and Canadian cities, 1381
use of, in Canada, 1391
Metropolitan areas; water supply problems of, 1880
Metropolitan districts; *see* Districts
Metropolitan Life Insurance Co.; San Francisco office of, gastro-enteritis epidemic in, 1263
Miami, Fla.; special rates and free water in, policy on, 1630
Microspira desulfuricans; characteristics of and corrosion by, 147
Minneapolis; joint administration of water and sewer accounts in, 1916
lime recovery from water softening sludges in, 741
maintaining efficiency of centrifugal pumps in, 849
Montana; short schools in, 616
Motion pictures; water works; specifications for construction of, 202
use of, for publicity, 201
Municipal Finance Officers Association; opinion of, on special utility rates to federal housing projects, 1643
Mutual water companies; problems of, 894

N

Nassau County, N. Y.; health department defense measures in, 701
National Board of Fire Underwriters; developments in fire protection by, 974
National Plumbing Laboratory; work of, 1569
Navigation; benefits to, through Willamette Valley Project, 721
capability of, decision of Supreme Court on, of New River, 315
New Jersey; effect of population trends on water supply in, 829
northern; hydraulics of large pipe lines for supply of, 1
water supply defense in, 1517
New Orleans; special rates and free water in, policy on, 1632
New River; decision of Supreme Court on navigability of, 315
dissenting opinion of Supreme Court on navigability of, 338
New York City; defense measures for water system of, 689
water system of, 690
New York Water Service Corp.; billing procedure of, 2201
Newark, N. J.; hydraulics of large pipe lines for supply of, 1
Nitrates; determination of, by modification of the phenoldisulfonic acid method, 1589
Nitrite nitrogen; *see* Nitrogen
Nitrogen; ammonia; determination of, 2113
natural; relationship of, to formation of chloramines, 2095
nitrite; determination of, 2115
Norfolk, Va.; loss of chlorine-ammonia residuals through aerators at, 2097
Nose; efficacy of, in determining threshold odor values, 1956

O

Odors; *see* Tastes and odors
Ohio; reforestation of water works properties in, 1175
Ohio River Pollution Survey; *see* U. S. Public Health Service
Oil; road; lining earth reservoir embankments with, 876
Olfactory membrane; efficacy of, in determining threshold odor values, 1956
Operation; normal; civil service in, limitations of, 1601
problems in, at Wichita, 1233
recording of, automatic devices for, 1195
standardization of, difficulty of, 1815
Operators; *see also* Personnel
contribution to, by salesmen, 1076
demands by, of salesmen, 1069
Orange, Va.; control of corrosion at, 299
Ordinances; *see also* Regulation
model; re: cross-connection, interconnection and back-flow protection, 571
quotations from, of various U. S. cities, on cross-connection, inter-connection and back-flow protection, 458
Oregon; State Board of Health; mobile laboratory units of, 644
Willamette River Valley Project; relation of, to water supply, 721
Ottawa, Ill.; distribution system analysis in, by Hardy Cross method, 225
Ottawa, Ont.; corrosion control studies at, 1409

Oxygen; dissolved; determination of, nomograph for, 1111
Ozone; generation of, equipment for, 2037
taste and odor control by, 2132
treatment with; at Whiting, Ind., 2035
operation and cost data on, 2043

P

Painting; preparation of surfaces for, 311
protection of metals by, 309
tank; materials for, experimental studies on, 1553
Papers; *see* Reports
Parkersburg, W. Va.; new method of cleaning wells in, 145
Pasadena, Calif.; construction of earth reservoir embankments with road oil linings at, 876
Pennsylvania; flood-forecasting service in, 213
Western; iron removal in water supplies of, 1929
Pequannock pipe lines; history and hydraulics of, 4
Personnel; *see also* Civil service, Operators, Short schools
appointed and elected, relation between, 84
certification of, plan for, in Tennessee, 625
status of, listed by states, 631
defense measures in choice of, 123
experienced; need for, in defense of water supplies, 703
group insurance for, Iowa practice in, 1496
licensing of, status of, listed by states, 631
loyalty of, importance of, to defense, 1477, 1863
management of; problems in, 1592
part of, in public relations, 1482
position of, developments in, during past 25 years, 739
raising standards of, 95
relations; in East Bay Municipal Utility District, 1908
repair crew; type of, for defense of New York City water system, 699
retirement of; organization for, in East Bay Municipal Utility District, 1908
planning for, 1489
selection of; at Wichita, 1233
various methods for, 84
social security for; application of present and proposed laws to, 1489
training of, for emergency chlorination work, 1320
pH; correction of; for control of corrosion, 286
effect of, on destruction of cysts of *Endameba histolytica*, 1713
raising of, to correct corrosive water, 295
Phenoldisulfonic acid method; modification of, for determination of nitrates, 1589
Phosphate; commercial; feeding of, to correct corrosive water, 295
Photo-electric cell; use of, in colorimeter, 660
Pipe; *see also* Distribution systems, Mains, Services, Transmission systems
capacity; effect of chlorine-ammonia treatment on, 2102, 2103
cast-iron; developments in, during past 25 years, 737
coating of; *see* Coatings
corrosion of; *see* Corrosion
electric grounding of; effect of, program for research on, 1541
friction losses in, reduction of, by chlorine-ammonia treatment, 2103
joints in; asbestos rope for, 772
cement for, for improved water quality, 769
mechanical; use of in emergency repairs, 1800
necessity for sterilizing, 769
repair equipment for, 1790
large; hydraulics of, trends in, 1
laying of; costs of, in East Bay Municipal Utility District, 749
pollution prevention in, in Britain, 1119
lining of; *see* Linings
parallel systems of, computation of equivalent lengths in, 237
steel; cleaning of, in preparation for bituminous lining, 1725, 1733
fittings and specials for, 1751
priming of, in preparation for bituminous lining, 1725, 1736
reducers for, use of, in emergency repairs, 1797

specifications for, list of, prepared by Committee 7A, 1716
Plankton; *see* Algae
Plumbing; *see also* Back-flow, Cross-connections, Inter-connections
fixtures; standardization of, 1565
protection of, against back-flow and back-siphonage, 391, 495
terminology of, problems of, 1566
Polarographic method; use of, in grounding research program, 1548
Pollution; *see also* Contamination
distribution system; *see* Distribution systems
lake; ozonation to overcome, 2035
stream; recent studies of, in West Virginia, 1085
two groups of flagellated algae as indicators of, 1100
Population; relation of meter rates to, 1653
relation of, to water supply, 827
urban; changing concentrations of, in U. S., effect of, on water supply, 1876
Potassium permanganate; taste and odor control by, 2132
Power; electric; grounding of, on water pipe, effect of, program for research on, 1541
portable sources of, use of, in emergency distribution system repairs, 1781
proposed development of, in Willamette Valley Project, 721
use of, in pumping plants, 844
utilities; opinion of, on special rates to federal housing projects, 1642
plants; machinery of; insurance of, inspection service and types of coverage offered for, 2192
Pre-chlorination; *see* Chlorination
Pressure; atmospheric; corrections for, in dissolved oxygen determinations, 1114
distribution system; control of, by automatic devices, 1193
Priorities; information on; *immediately following Abstract Section in July, August, September and November issues*
Preference Rating Order P-46, 1854
problem of, in defense program, 1476
Protection; *see* Defense
Public relations; development of, in gaining acceptance of meterization program at Scottsburg, Ind., 1219
motion pictures in, 201
practices in, in East Bay Municipal Utility District, 1905
present state of, 91
relation of A.W.W.A. to, 93
scientific approach to, 1481
Publication; writing for, criteria for, 1500
Publicity; *see* Public relations
Pumping; facilities for, at Cincinnati, 1201
interruptions in, prevention of, at Buffalo, 1586
Pumps; centrifugal; performance of, 837
testing techniques for, 850
developments in, during past 25 years, 735
electric power for, 844
portable; use of, in emergency distribution system repairs, 1779
selection of, factors in, for small water works, 853
various types of, at new Toronto plant, 1014
Purification; *see also* Treatment
equipment for, at Toronto, 1011
ozone for, at Whiting, Ind., 2035
stream; flow augmentation for, through Willamette Valley Project, 721

Q

Quality; bacterial; distribution system investigation of, 1429
Treasury standard of, lack of compliance with, of small filtration plants treating surface water, 913
proposed changes in, 1805, 1826, 2215
characteristics of, for various waters supplying northern New Jersey, 51
chemical; Treasury standard requirements in, proposed changes in, 1806, 2215
improvement in, by use of cement joints, 769
indicators of, two groups of flagellated algae as, 1099

physical; Treasury standard requirements in, proposed changes in, 1806, 2215
Treasury Drinking Water Standard; amendment of test portions recommended for, 1242.
contemplated revision of, 609, 1804, 2215

R

Racine, Wis.; development of photoelectric method of residual chlorine determination at, 659
Radio; emergency communication by, 1166
Rantoul, Ill.; distribution system analysis in, by Hardy Cross method, 231
Rates; domestic; Canadian practices in, 1390
fire protection; Canadian practices in, 1395
meter; relation of, to distribution system conditions, 1653
variation in, factors in, 1653
municipal service; Canadian practices in, 1395
practices in, in East Bay Municipal Utility District, 1904
schedules for, design of, as a factor in good management, 1162
sewer rental; adjustments to, in special cases, 1918
structure of, 1915
special; application of, on all utilities, to federal housing projects, 1638
Canadian practice on, 1400
experiences with, in various U. S. cities, 1629
legal aspects of, 1644
problem of, 1627
Rating; *see* Grading
Raw water; need for standards for, 1809
Records; *see also* Accounting
importance of, to good management, 1164
Reducers; steel; use of, in emergency distribution system repairs, 1797
Reforestation; conservation of Ohio water works properties by, 1175
Regional supplies; *see* Supply
Regulations; *see also* Ordinances
government; of public water supplies, limitations of, 1816
Rental; sewer; *see* Rates
Repair; *see* Maintenance
Reports; preparation of, criteria for, 1500
Research work; critical appraisal of, 1497
reporting of, criteria for, 1500
Reservoirs; depth sampling in, apparatus for, 2207
impounding; control of algae in, by copper sulfate, 705
increasing capacity of, in Creston Iowa, 957
multiple use of, on Willamette Valley Project, 721
silting in, control of, 1022
storage; earth embankments of, lining of, with road oil, 876
new design of, at Syracuse, N. Y., 861
Residual chlorine; *see* Chlorine
Retirement; personnel, *see* Personnel
Richardton, N. D.; corrosion experience at, 293
Richmond, Va.; annexation of suburban areas by, 1881
preparation of water for filtration by super-chlorination and de-chlorination at, 249
Rivers; navigability of, *see* Navigation
Rochester, N. Y.; pollution and emergency disinfection of water supply at, 1334
Rockaway conduits; history and hydraulics of, 27

S

Sabotage; *see* Defense
St. Paul, Minn.; joint administration of water and sewer accounts in, 1917
Salesmen; contributions by, to operators, 1076
demands on, by operators, 1069
Salinity; irrigation water; effect of, on soil and plants, 885
Sampling; depth; apparatus for, in streams and reservoirs, 2207
methods of, for water analysis in Venezuela, 281
standardization in; for fluoride determinations, 1969
need for, 1814, 1822, 2215
San Francisco; emergency chlorination equipment at, 1327
gastro-enteritis epidemic in, 1263
World's Fair; *see* Treasure Island

Sand; *see* Filters
Schools; *see* Short schools
Scioto River; pollution of, determination of, by use of two groups of flagellated algae, 1100
Scottsburg, Ind.; 100 per cent meterization program at, 1218
Sedimentation; control of, to prevent silting in reservoirs, 1035
Service; customer; *see* Public relations
pumping station; interruptions to, prevention of, 1586
Services; *see also* Distribution systems, Pipe
lead; corrosion of, inhibition of, with sodium hexametaphosphate, 1179
Settings; meter; *see* Meters
Sewage works; defense of, in Britain, 1444
Sewers; service charges for, joint collection of, with water bill, 1911
Short schools; courses for, 620
experience with, in Montana, 616
faculty problems of, 614
report on, in Indiana, 618
theory of, 611
Silica; influence of; on corrosion, 906
on flocculation, 909
Silting; reservoir; control of, factors in, 1022
Sludge; water softening; lime recovery from, 741
Sluice gates; tentative standard specifications for, *immediately following page 1860*
Soap cost; effect of softening on, 111
effect of zeolite softening on, in South Orange, N. J., 275
Social security; *see* Personnel
Soda ash; feeding of, to correct corrosive water, 295
Sodium; diethyldithiocarbamate; use of, in rapid determination of zinc, 246
hexametaphosphate; effect of, on distribution systems, 1537
inhibition of lead corrosion with, 1179
solution of lead by, 1538
stabilization of water with, at Wichita, 1238
zeolite; iron and manganese removal with, 1931
Softening; census of municipal plants using, 2153
effect of, on irrigation water, 883
iron removal combined with, in Western Pennsylvania supplies, 1930
lime and lime-soda; iron and manganese removal in, 1941
lime recovery from sludge produced in, 741
municipal and household; comparative costs of, 116
present status of, in Wisconsin, 114
zeolite; cost of, 261
use of, at South Orange, N. J., 255
Soil Conservation Service; *see* U. S. Department of Agriculture
Soil solution; effect of irrigation on, 885
Solids; percentage of, determination of, in water softening sludges, 747
removal of, rate of, at different layers in filters, 934
South Orange, N. J.; zeolite softening in, 255
Southern California; *see* California
Specials; steel pipe; various types of, 1754
Specifications; *see also* American Water Works Association
filtering material; progress in preparation of, 2021
plumbing, 1575
pump; factors in drawing up, for small water works, 853
steel pipe and coatings; list of, prepared by Committee 7A, 1716
Standards; drinking water; *see* Quality
plumbing; progress in development of, 1565
Steel; *see also* Pipe, Services, Mains, Tanks
bacterial corrosion of, 147
protection of; coating materials for, 1553
Sterilization; *see also* Chloramination Chlorination
early studies in, 2127
importance of, of new or repaired mains, 771
present practices in, in Britain, 1116, 1443
Suburban areas; *see also* Metropolitan areas
meter rates in, 1660
Sulfide; measurement of, in low concentrations, 943

Sulfur; dioxide; de-chlorination with, at Richmond, Va., 253
oxidation of, corrosion of iron and steel caused by, 158
Super-chlorination; *see* Chlorination
Supply; auxiliary; development of, for emergency service and defense, 680
provision of, for fire protection, 972
development of, in West Virginia, 948
emergency sources of, use of, in defense, 1867
failure of, during drought, in Creston, Iowa, 953
ground water; use of, in Houston, Tex., 1769
improvements to, in Creston, Iowa, 957
investigation of, in Canada, 967
protection of, for New York City, 689
proximity of, relation of, to meter rates, 1660
regional; recent trends in, 1875
relation of population trends to, 827, 1875
small; application of drinking water standards to, 1808
Supreme Court; *see* U. S. Supreme Court
Surpluses; *see* Funds
Syracuse, N. Y.; new type storage reservoir at, 861

T

Tacoma, Wash.; water system of, automatic recording and control devices in, 1188
Tanks; *see also* Distribution systems
cathodic protection of, *see* Cathodic protection
cleaning of, methods for, 1555
coatings for, *see* Coatings
corrosion of, *see* Corrosion
steel; circular; combination of three, in new storage reservoir at Syracuse, N. Y., 863
Tastes and odors; control of; *see also* Chloramination, Chlorination, Treatment
bibliography of, 2144
effectiveness of chloramines in, 2097, 2137
history of, 2124
super-chlorination as a means of, 168
detection of; by consumers, 1959
efficacy of olfactory membrane in, 1956
evaluation of; methods of, history of, 2143
threshold odor method of; accuracy of, 1945
history of, 2143
short-parallel modification of, 1960
twilight zone modification of, 1949
occurrence of, in Kanawha and Elk Rivers, 1087
twilight zone of, measurement of, 1961
Tate process; *see* Lining; cement mortar
Taxes; burden of, on mutual water companies, 898
Telephone; *see* Communication
Temperature; effect of, on algae growth and control in impounding reservoirs, 707, 717
water; effect of, on corrosive attack by various waters, 1419
Tennessee; certification of operators in, 625
Thiobacilli; corrosion of iron and steel by, 158
Threshold odor method; *see* Tastes and odors; evaluation of
Toledo, Ohio; cement-mortar lining of steel trunk mains at, 1682
Toronto, Ont.: new purification plant and pumping station at, 1011
Trailer laboratory; *see* Laboratory, mobile
Transmission systems; *see also* Pipe
developments in, during past 25 years, 734
inter-connection of, for protection of supply, in New Jersey, 1523
protection of, for New York City supply, 689
Treasure Island; emergency chlorination at, 1332
Treasury Drinking Water Standard; *see* Quality
Treatment; *see also* Chloramination, Chlorination, Purification
changes in, effect of, on distribution systems, 1536
conditioning; methods of, to inhibit corrosion, committee report on, 1534
copper sulfate; algae control in im-

pounding reservoirs by, 705, 2108
taste and odor control by, 2129
laboratory control of, adequacy of present methods of, 1251
ozone installation of, at Whiting, Ind., 2035
sodium hexametaphosphate; *see* Sodium hexametaphosphate
Trucks; *see* Automotive equipment
Tulsa, Okla; special rates and free water in, policy on, 1629
Turbidity; effect of, on coagulation, 911
Twilight zone; *see* Tastes and odors
Typhoid; *see* Disease

U

United States; Department of Agriculture; Soil Conservation Service; work of, in control of reservoir silting, 1024
Federal Bureau of Investigation; work of, in water works defense, 1861
Federal Communications Commission; rules of, re: emergency radio communication, 1167
Housing Authority; utility service for projects of, special rates for, 1639
Public Health Service; Ohio River Pollution Survey; mobile laboratory units of, 636
Scioto River pollution study by, 1100
use of equipment of, in West Virginia pollution studies, 1086
Supreme Court; decision of, on navigability of New River, 315
dissenting opinion of, on navigability of New River, 338
Unit hydrograph; flood forecasting by, in Pennsylvania, 215
Urban areas; *see* Metropolitan areas

V

Vacuum breakers; protection of cross-connections and inter-connections with, 441
Valves; control; automatic; use of, in Tacoma, Wash., 1193
gate; use of, to protect pumping station against service interruptions, 1586
importance of, in defense of water supply works, 1441, 1478
maintenance of, insurance requirements for, 1066
protection of cross-connections and inter-connections by, 441
Venezuela; state water analysis laboratory in, 277

W

Wanaque aqueduct; history and hydraulics of, 33
War; *see* Defense
Washing; filter; *see* Filters
Washington, D. C., Suburban Sanitary District; development of, 1881
Watersheds; recreational use of, developments in, during past 25 years, 734
Wells; *see also* Ground Water
capacity of, consideration of, in preparing drilling code, 140
cleaning of, new method of, in Parkersburg, W. Va., 145
control of, at Wichita, 1234
drilling of, control of, benefits to health and efficiency from, 138
West Virginia; development of public water supplies in, 948
recent stream pollution studies in, 1085
Westchester County, N. Y.; auxiliary supply for, 680
Western Pennsylvania; *see* Pennsylvania
Whiting, Ind.; ozonation at, 2035
Wichita, Kan.; water system of, operation problems in, 1233
Willamette Valley Project; *see* Oregon
Wisconsin; law in, on allocation of water works funds, 98
probable effect of water softening in cities of, 103

Z

Zeolite; manganese; iron and manganese removal with, 1937
natural; cost of softening by, compared with by synthetic, 256
regeneration of, brine method for, use of, at South Orange, N. J., 267
sodium; iron and manganese removal with, 1931
synthetic; use of, for softening at South Orange, N. J., 259
Zinc; determination of, rapid method for, in water supplies, 246

Author Index

ALEXANDER, ED F., legal phases of Cincinnati water works operation, 1215

ALEXANDER, L. J. AND EBAUGH, R. M., cement joints for improved water quality, 769

ALFKE, CHARLES J., population trends and water supply, 827

ALLAN, L. F., *see* SANDERSON, A. U.

ALT, EDWARD E., what a salesman can offer an operator, 1076

ANDERSON, E. D., costs of distribution system extensions beyond corporate limits in northern Indiana, 1053

ARNOLD, G. E., experiences with emergency chlorinating equipment, 1327

BAHLMAN, CLARENCE, new filtration plant at Cincinnati, 1206

BARDWELL, R. C., *Vice-Chairman*, report of the Joint Research Committee on Boiler Feedwater Studies, 1402

BARNARD, RUSSELL E., fittings and specials for steel pipe, 1751

BARRON, J. L., health department defense measures in Nassau County, N. Y., 701

BARTUSKA, JAMES F., ozonation at Whiting, Ind., 2035

BAYLIS, JOHN R., water purification plants and water quality standards, 1824

BECKWITH, T. D., bacterial corrosion of iron and steel, 147

BERGMAN, LEONARD A., protection of Buffalo's pumping station against service interruption, 1586

BERRY, A. E. AND STORRIE, WILLIAM, water rate structures in Canada, 1389

BERRY, F. R., financial considerations of distribution system extensions, 1041

BILLINGS, L.C., *discussion*—revising the U. S. standards for drinking water quality, 2221

BLACK, A. P., *Chairman*, report of the Committee on Methods of Determining Fluorides, 1965

BLACKBURN, DUNCAN A., construction of earth reservoir embankments with road oil linings, 876

BLAKELEY, L. E., mutual water companies and domestic water, 894

BLANKENSHIP, R. L., corrosion experience at Orange, Va., 299

BOSCH, HERBERT AND WOLMAN, ABEL, bacteriological quality of water from small filtration plants treating surface waters, 913

BROWN, CARL B., factors in control of reservoir silting, 1022

BRUSH, WILLIAM W., twenty-five years advance in water works, 732

BUCHANAN, E. V., discussion on civil service, 1609

BURGESS, JOHN, centrifugal pump performance, 837

BUSWELL, A. M., *discussion*—revising the U. S. standards for drinking water quality, 2219

CALVERT, C. K., *discussion*—bacterial corrosion of iron and steel, 165

special section of committee report on chlorine-ammonia treatment, 2108

CAPEN, CHARLES H., JR., trends in coefficients of large pressure pipes, 1; *erratum*, 364

relation of meter rates to distribution system conditions and other factors, 1653

CARROLL, E. B., control of iron bacteria by super-chlorination, 168

CARSON, H. Y., emergency repairs to distribution systems, 1800

CHANG, S. L. AND FAIR, GORDON M., viability and destruction of the cysts of *Endameba histolytica*, 1705

CHASE, E. SHERMAN, *discussion*—revising the U. S. standards for drinking water quality, 2223

CHEVALIER, WILLARD, national defense and the individual, 1307

CLARK, LLOYD K., corrosion experience at Richardton, N. D., 293

COLT, ROBERT M., national defense council at Gloversville, N. Y., 1869
COWLES, M. W., progress in plumbing standardization, 1565
COX, CHARLES R., drinking water standards, 1807
CRABILL, M. P., methods of handling sand and gravel, 1221
CRANE, HAROLD L., lowering cast-iron mains under pressure, 764
CRIST, MARION L., special section of committee report on chlorine-ammonia treatment, 2103
CRITCHLOW, H. T., water supply defense in New Jersey, 1517
CROWLEY, A. B., *see* GEIGER, J. C.

DAHLJELM, IRVING L., corrosion control by pH correction, 286
DANDRIDGE, E. F., financing of extensions at Los Angeles, 219
DEMARTINI, F. E., mobile laboratory units of the Ohio River Pollution Survey, 636
DEVENDORF, EARL, pollution and emergency disinfection of Rochester's water supply, 1334; *erratum*, 1626
DOLAND, J. J., flow and loss of head in distribution systems, 234
DUHME, RALPH E., pumping plants at Cincinnati, 1201

EBAUGH, R. M., *see* ALEXANDER, L. J.
EBERLING, CARL A., history of Cincinnati water supply, 1201
cement lining of a water main at Cincinnati, 1693
ELIASSEN, ROLF, clogging of rapid sand filters, 926
program for research on the effects of electric grounding on water pipes, 1541
ELVOVE, ELIAS, *discussion*—methods of determining fluorides, 2210

FABER, HARRY A., chlorination equipment for emergency use, 1319
literature survey for committee report on chlorine-ammonia treatment, 2080, 2121
FAIR, GORDON M., *see* CHANG, S. L.
FAIRMAN, F. I., electric power for water pumping plants, 844
FARNSWORTH, GEORGE, JR. AND ROSSANO, AUGUST, JR., application of the Hardy Cross method to distribution system problems, 224
FARR, F., JR., *see* HOWLAND, W. E.
FARRELL, LOUIS L., pipe laying costs of the East Bay Municipal Utility District, 749
FEBEN, DOUGLAS, *see also* HULBERT, ROBERTS
discussion—accuracy of threshold odor values, 1956
FINCH, LEWIS S., control of water well drilling, 138
FITZGERALD, R. W., special section of committee report on chlorine-ammonia treatment, 2097
FOOTE, H. B., water works schools, 611
notes on water works defense, 1867
FRY, JAMES H., certification of operators in Tennessee, 625
FUGATE, G. L., development of Houston's water supply, 1768

GARRATT, JAMES E., *discussion*—population trends and water supply, 832
GEIGER, J. C., CROWLEY, A. B. AND HYDE, C. G., gastro-enteritis epidemic in a large office group, 1263
GERSTEIN, H. H., special section of committee report on chlorine-ammonia treatment, 2095
GEUPEL, LOUIS A., utility co-ordination in emergencies, 1079
control of automotive equipment, 1362
GIDLEY, H. K., development of public water supplies in West Virginia, 948
GILCREAS, F. W., *Chairman*, report of the Committee on Chlorine-Ammonia Treatment of Water, 2079
GLEDHILL, E. G. B. AND MCCANLIS, A. W. H., pollution prevention in distribution systems in Britain, 1116
GLEESON, G. W., fundamentals of corrosion, 1249
GOIT, LAURANCE E., mechanical application of bituminous coatings and linings, 1723
GOODHUE, R. F., insurance requirements for water works properties, 1058
GOUDEY, R. F., practical aspects of cross-connection, inter-connection and back-flow protection, 391

discussion—methods of determining fluorides, 2213
GRAHAM, A. F., machinery breakdown insurance, 2192
GREEN, CARL E., Oregon mobile laboratory, 644
GRIFFIN, A. E., special sections of committee report on chlorine-ammonia treatment, 2088, 2095, 2095, 2102, 2115

HANSEN, PAUL, *Chairman*, progress report of the Committee on Specifications for Filtering Materials, 2021
HARKNESS, BRUCE, cleaning and cement lining water mains in place, 1700
HASSLER, JOHN W., *discussion*—accuracy of threshold odor values, 1958
HASSLER, WILLIAM W., history of taste and odor control, 2124
HATCH, G. B., inhibition of lead corrosion with sodium hexametaphosphate, 1179
HATFIELD, W. D., nomograph for determining dissolved oxygen concentration in water, 1111
HELBIG, W. A., *discussion*—accuracy of threshold odor values, 1963
HICKEY, JOHN A., *discussion*—joint administration and collection of water and sewer accounts, 1923
HIRSCH, A. A., *discussion*—revising the U. S. standards for drinking water quality, 2220
HOCHLERNER, TOBIAS, defense measures for New York supply, 689
HOFFMAN, M. F., commercial division of Cincinnati water department, 1214
HOOVER, JOHN EDGAR, water supply facilities and national defense, 1861
HOPPE, T. C., determination of nitrates in water by modification of the phenoldisulfonic method, 1589
HOSKINS, J. K., some considerations in the revision of the Treasury standard, 1804
discussion—revising the U. S. standards for drinking water quality, 2218
HOWARD, NORMAN J., defense of water supply works, 1475
HOWLAND, W. E. AND FARR, F., JR., computation of equivalent lengths of parallel pipe systems, 246
HOWSON, LOUIS R., what water softening would do for Wisconsin cities, 103
management of water works, 1161
discussion—development of Houston's water supply, 1777
HUDSON, H. E., JR., abstracts on filtering materials, 2025
HUGHES, GEORGE F., finance and accounting of Denver's water system, 1648
HULBERT, ROBERTS AND FEBEN, DOUGLAS, studies on the accuracy of threshold odor values, 1945
HURLBUT, W. W., *discussion*—emergency radio communication, 1173
current activities of the steel pipe committee, 1716
HUTSON, A. C., auxiliary water supplies for fire protection, 972
HYDE, C. G., *see* GEIGER, J. C.

INGLEE, CLINTON, temporary make-ups and line caps, 1786

JACKSON, J. O., experimental studies of tank coating materials, 1553
JACKSON, L. A., survey of water main extension policies, 1357
JONES, H. SEAVER, reconditioning water mains by cement lining, 1695
JORDAN, HARRY E., public water supply in the civil defense program, 121

KAMPS, J. M., cleaning and lining with bitumastic enamel, 1763
KEITH, J. CLARK, experiences with cathodic protection of water tanks, 1503
KERSHAW, NEIL, *discussion*—accuracy of threshold odor values, 1963
KING, KENNETH K., meter reading and commercial department operation, 1373
KLEINHENZ, JOHN E., *discussion*—how to make a motion picture of the water works, 208
KUNIGK, W. A., automatic recording and control devices in Tacoma's water system, 1188
KURANZ, A. P., survey of meter maintenance practice, 1381

LACKEY, JAMES B., two groups of flagel-

AUTHORS

lated algae serving as indicators of clean water, 1099
LaDue, Wendell R., cement lining of water mains at Akron, Ohio, 1671
Lathrop, T. R., reforestation of Ohio water works properties, 1175
Lee, John C. H., relation of Willamette Valley Project to water supply, 721
Lenhardt, L. G., *discussion*—special rates for federal housing developments, 1647
Leverin, Harald A., investigatoin of Canadian water supplies, 967; *errata notice*, 1160
Livermore, Frank D., the water superintendent and the elected official, 84; *erratum*, 364
Longwell, J. S., *discussion*—regional water supplies, 1894
management problems of a municipal utility district, 1897
Lordley, Howard E., *see* Smith, Marsden C.

Maffitt, Dale L., social security legislation and retirement planning affecting water works employees, 1489
special rates and free water service, 1627
Magistad, Oscar C., use of softened Colorado River water for home gardens, 883
Mangan, John W., flood-forecasting service in Pennsylvania, 213
McCanlis, A. W. H., *see* Gledhill, E. G. B.
McCarthy, John J., Racine method of residual chlorine determination, 659
Meacham, J. A., metal protective finishes, 309
Mellett, John C., public relations begin at home, 1481
Milligan, T. E., *Chairman*, report of the Indiana Section Sub-Committee on Meter Settings, 1666
Monie, William D., algae control, 705
Montillon, G. H., corrosion and cathodic protection, 302
Moore, Edward W., *Chairman*, progress report of Committee on Water Conditioning Methods to Inhibit Corrosion, 1534
Moore, Robert E., Jr., legal aspects of cross-connection, inter-connection and back-flow protection, 495
Morgan, L. S. and Young, C. H., iron removal in Western Pennsylvania water supplies, 1929
Morse, H. S., *discussion*—regional water supplies, 1893

Nalefski, L. A., what an operator expects from a salesman, 1069
Nelson, Thurlow C., *discussion*—algae control, 716
Newsom, Reeves, statement re: depreciation, 359
discussion—population trends and water supply, 833
Noble, Ralph E., testing larger portions of water for coliform bacteria, 1242
discussion—revising the U. S. standards for drinking water quality, 2224
Norcom, George D., revising the U. S. standards for drinking water quality, 1819
Chairman, report of the Committee on Methods of Water Treatment and Laboratory Control, 2051
Norton, John F., critical appraisal of experimental work, 1497

Ogden, William H., billing procedure for a group of small plants, 2201
Olsen, Arthur K., Creston, Iowa, solves its water problem, 953
Olson, H. M., *discussion*—water softening for Wisconsin cities, 119
census of U. S. municipal water softening plants, 2153

Pedersen, H. V., the superintendent of tomorrow, 91
Pirnie, Malcolm, *Chairman*, report of the Committee on Water Works Practice, 343
Pomeroy, Richard, measuring low sulfide concentrations, 943
Poole, George J., maintaining efficiency of centrifugal pumps, 849
Probst, John B., values of an adequate civil service system, 1591
Pulham, C. J., *see* Wood, W. H.

AUTHORS

RICHETTA, J. D., Indiana district and short schools, 618
RICHEY, DALE, relative value of 2 per cent and 5 per cent brilliant green bile confirmatory media, 649
RIDDICK, THOMAS M., notes on current corrosion problems, 903
notes on current flocculation problems, 908
RIEHL, MERRILL L., rapid method for the determination of zinc in water supplies, 246
RIMMER, JAMES H., distribution system maintenance at Cincinnati, 1211
ROBBINS, EVERITT, 100 per cent meterization program, 1218
ROGERS, M. E., operation problems in the new Wichita water system, 1233
ROSSANO, AUGUST, JR., *see* FARNSWORTH, GEORGE, JR.

SAHND, WILLIAM, distribution system at Cincinnati, 1210
SANCHIS, J. M., water analysis laboratory of the Public Works Ministry of Venezuela, 277; *erratum*, 826
SANDERSON, A. U. AND ALLAN, L. F., Toronto's new purification plant and pumping station, 1011
SCHOONMAKER, GEORGE N., cement lining of water mains at Toledo, Ohio, 1682
SCOTT, R. D., modification of the fluoride determination, 2018
SCOTT, ROSSITER S., main and joint repair equipment, 1790
SHANNON, ALBERT M. AND WALLACE, WILLIAM M., investigating water quality in a distribution system, 1429
SMITH, HAL F., special rates for federal housing developments, 1638
discussion—joint administration and collection of water and sewer accounts, 1926
SMITH, L. A., effective management under municipal ownership, 97
SMITH, MARSDEN C. AND LORDLEY, HOWARD E., super-chlorination and de-chlorination, 249
SOWDEN, HOWARD J., lime recovery from water softening sludges, 741
STEWART, E. P., new type reservoir at Syracuse, N. Y., 861
STOCKWELL, H. P., JR., studies in corrosion control, 1409
STORRIE, WILLIAM, *see* BERRY, A. E.
SUTER, MAX, *discussion*—bacterial corrosion of iron and steel, 166
SWACKHAMER, ROBERT J., protective lighting of water works, 671

THOMAS, DAVID S., notes on water works defense, 1866
THOMPSON, LEONARD N., *Chairman*, report of the Committee on Joint Administration and Collection of Water and Sewer Accounts, 1911
THOMPSON, NELSON, portable pumping and power equipment, 1779
THRASHER, W. E., auxiliary supply in Westchester County, N. Y., 680

UNDERWOOD, GOLDEN, cleaning wells at Parkersburg, W. Va., 145

VAN BRUNT, J. K., cleaning mains at Manasquan, N. J., 755
VAN NORMAN, H. A., limitations of civil service, 1596

WALKER, C. C., pumps for small water works, 853
WALLACE, WILLIAM M., *see* SHANNON, ALBERT M.
WATSON, K. S., recent stream pollution studies in West Virginia, 1085
WEIR, W. VICTOR, emergency radio communication, 1166
how to make a motion picture of the water works, 201
WESTON, ROBERT SPURR, zeolite softening at South Orange, N. J., 255
WOLMAN, ABEL, *see also* BOSCH, HERBERT regional water supplies, 1875
discussion—revising the U. S. standards for drinking water quality, 2215
WOOD, W. H. AND PULHAM, C. J., protection of utility services in wartime, 1440

YOUNG, C. H., *see* MORGAN, L. S.

Index of Abstract Topic Headings

Accounting and Financing, 1151
Administration, Personnel and Public Relations, 801, 1147
Algae Control, 1296
Apparatus, *see* Laboratory Methods

Bacteriology, 184, 995, 1849
Boilers and Feed Water, 365

Chemical Feeding, Conditioning and Sedimentation, 377, 1843
Chemistry, 1000, 1845
Conditioning, *see* Chemical Feeding
Corrosion and Corrosion Control, 807

Dams, 815
Defense, 171, 779, 1125, 1271, 1612
Distribution Systems—Construction and Maintenance, 983, 2061

Feed Water, *see* Boilers
Filtration, 387, 1832
Financing, *see* Accounting

Ground Water, *see* Wells

Health and Hygiene, 174, 1298
Hydrology, 1287
Hygiene, *see* Health

Impounding Reservoirs, 1294
Industrial Water Supply, 1145
Iron Removal, *see* Softening

Laboratory Methods—Equipment and Apparatus, 988

Maintenance, *see* Distribution Systems
Meters, *see* Services

Odor Control, *see* Taste and Odor Control

Personnel, *see* Administration
Pollution, *see* Stream Pollution
Public Relations, *see* Administration
Pumps and Related Equipment, 976

Quality, 195

Rates, 1156
Reservoirs, *see* Impounding Reservoirs

Sedimentation, *see* Chemical Feeding
Services and Meters, 2068
Softening and Iron Removal, 382, 1837
Stream Pollution and Its Control, 1277
Supply, *see* Water Supply

Taste and Odor Control, 1841
Treatment—General, 372, 1618

Water Supply—General, 1132
Water Supply—Industrial, *see* Industrial
Wells and Ground Water, 197, 2072

Abstract Subjects

A

Accidents; *see* Hazards, Safety
Accounting; 1151 *ff.*
  relation of, to rate analysis technique, 1156
Activated carbon; taste and odor control with, 1842
Acuformis Perennis; characteristics of, 195
Administration; 801 *ff.*, 1147 *ff.*
  effect of war on, 1617
Aeration; equipment for; design of, 1618
Aer. aerogenes; see Coliform bacteria
Aerobacter clocae; gas production by, variations in, 998
Aerobic cultivation; clear liquid medium for, of anaerobes, 999
Agar; hardness of, determination of, 1852
  standard, comparative study of, 1851
Agitator; design of, inexpensive, 990
  surface, experiences with, 1836
Aggressivity; newer opinions on, 1008
Air; colorimetric determination of small quantities of chloropicrin in, 1849
  dangerous concentrations of chlorine in, automatic detection of, 1847
  release of, dissolved in water, 1008
Air-conditioning; water for, use of corrosion inhibitors in, 1461
Airplanes; measuring reservoir capacity from, 1295
Airports, army; *see* Army
Alberta, Canada; waters of, fluorine content of, 1300
Alcohol; use of, in washing reclaimed silver nitrate crystals, leads to explosion, 1009
Algae; control of, 1296 *ff.*
  growth of, prevention of, by hypochlorous acid, 1456
Alkalinity; study of, with various coagulants, 1844
Allegheny River; watershed of, pollution of, 1283
Allen salt-velocity method; use of, in flow measurement, 1466
Alloys; by-product coke industry, corrosion tests on, 813
  corrosion of, by flue gases, 814
  potentials of, in sea water, 1458
Alum; use of, in sterilization, 1451
Alumina floc; x-ray diffraction study of, 1845
Aluminon; use of, in determination of aluminum, 1006
Aluminum; determination of traces of, with aid of aluminon, 1006
  sulfate; use of, for coagulation of natural waters at low temperatures, 380
Amebiasis; *see* Gastro-enteritis
Ammonia; aqua; use of, for chloramination, 382
  taste and odor prevention with, 1842
Amsterdam, Netherlands; water supply for, 1143
Anaerobes; aerobic cultivation of, clear liquid medium for, 999
Anaerobic flora; *Acuformis Perennis;* characteristics of, 195
Analysis; bacteriological; 184 *ff.*, 995 *ff.*, 1849 *ff.*
  boiler scale; method for, 368
  boiler sludge; method for, 368
  chemical; 1000 *ff.*, 1845 *ff.*
    importance of, in determining potability, 197
    interpreting results of, 197
    relationship of, to corrosivity, 1456
    significance of, in judging sanitary quality, 176
  colorimetric; determination of two-component color system by, 1006
    importance of temperature in, 1847
  dimensional; application of, to centrifugal pumps, 977
  flow; *see* Flow
Apparatus; laboratory, 988 *ff.*
Aqua ammonia; *see* Ammonia
Aquifers, characteristics of, 197
Army; airports; water supply for, 1617
  camps; water service to, extensions to distribution systems for, 1131

water supply and sewa gedisposal practices at, 800
well supply for, 1617
posts; sanitary report on supplies for, 175
sanitary engineers in, functions of, 1306
water supply for, 173, 174, 175
water supply troops in, functions of, 1613
Artesian wells; consideration of, on Ogden River project, 2077
Asthma; sulfur dioxide poisoning as a cause of, 184

B

Bacilli; dysentery; significance of occurrence of bacteriophage for, in water supplies, 999
typhoid and paratyphoid; isolation of, simple modification of the Wilson and Blair medium for, 999
Bacteria; coliform; *see* Coliform bacteria
contamination by, improbability of, as implement of war, 795
corrosion by, studies on, 810
reduction of, investigation of, in sand filters, 1835
Bacterial quality; modern conception of, 196
practical aspects of, 196
standards for, and treatment required, 196
Bacteriology; 184 *ff.*, 995 *ff.*, 1849 *ff.*
Bacteriophage; occurrence of, significance of, for dysentery bacilli in water supplies, 999
rôle of, in self-purification of streams, 187
Base exchange; capacity for, determination of, for soils and other materials, using the colorimetric manganese method, 1004
processes of, nomenclature in, 1000
Basophilia; appearance of, where water contains lead, 183
Bayou Duplantier Watershed; hydrologic data of, 1292
Belgium; purification practice in principal supplies of, 372
Benochlor; controlling aquatic vegetation with, 1296
Bethlehem, Pa.; 200 years of water works development in, 1135
Billeting; civilian; organization of, in Liverpool, 1129
Billing; triplicate forms for, 805
Biochemical oxygen demand; determination of, 1000
Biochemistry; of fermentation of rare sugars by coliform bacteria, 193
of scattered bromine, 1005
Bitumen; surfacing treatment of impounding reservoirs with, 1295
Boilers; 365 *ff.*, 1470 *ff.*
compounds for; use of, to combat scale, 370
feed water for; *see* Feed water
Bonding; electrical; cathodic protection of pipe lines by, 1462
Boston, Mass.; harbor of, pollution of, 1283
Brines; reclamation of, salt saving by, in zeolite plants, 1839
refrigeration; corrosion by, influence of dissolved oxygen and pH on, 812
Brisbane, Australia; water supply of, 1142
Britain; air raid precautionary measures in, 779
chlorination practices in, 375
dam foundation practice in, 815
observations on defense of, 1612
post-war reconstruction plans in, 1617
report of freshwater biological association in, 185
water supplies in, 1141, 1142
Bromine; scattered; geo- and biochemistry of, 1005
Broth; *see* Media

C

Calcium; carbonate; precipitation of, inhibiting action of minute amounts of sodium hexametaphosphate on, in ammoniacal solutions, 1002
hypochlorite; ion of, reaction of, with nitrites, 1847
preservation of, 1455
sterilization by, 1451, 1455
Calgon; *see* Sodium hexametaphosphate
California; State Division of Fish and Game of; pollution control work of, 1279
Canada; cost and consumption of water supplies in, 805
filtration practice in, current trends of, 1833, 1834

tax exemption of publicly owned utilities in, 1149
water works practice in, developments in, from 1850 to 1940, 1138
Carbon; activated; taste and odor prevention with, 1842
dioxide; dissolved; micro-determination of, in pond water, 1847
free; removal of, from natural waters, 1846
removal of, prior to softening, 1840
utilization of; relationship of, to succinic acid formation, by coliform bacteria, 189
Carbonate; calcium; precipitation of, inhibiting action of minute amounts of sodium hexametaphosphate on, in ammoniacal solutions, 1002
effect of, on production of plankton, 1297
Carbonate-ion concentration; effect of, in softening, 383
Caries; dental; study of, including *L. acidophilus* estimations, 1298
Casein; enzymic digestion of, in preparation of peptones, 1851
Cases; court; *see* Legal decisions
Casings; meter; cleaning of, by sand blasting, 2071
well; depth detectors for, 2077
Cathodic protection; constancy of, application in, 1462
corrosion prevention by, in distribution systems, 812, 813, 1461
electrical bonding for, 1462
minimum current required for, determination of, 812
relationship of current density to, 1462
surveys on, using portable potentiometer, 812
Cavitation; corrosion by, 815
occurrence of, in outlet conduits of high dams, 825
Cement; *see also* Concrete
soil corrosion of, 808
Certification; employee, 802
Chatham, Ont.; 1939 and 1940 reports of water works at, 1140
Chemical feeding; 377 *ff.*, 1843 *ff.*
equipment for; design of, 1620
Chemical industry; development of, influence of electrolytic processes on, 1448
water technology in, 1147
Chemistry; 1000 *ff.*, 1845 *ff.*
Chemung River; watershed of, pollution of, 1283
Chloramination; aqua ammonia for, 382
taste and odor prevention by, 1623, 1842
Chlorides; mercurometric determination of, in weakly mineralized drinking water, 1849
removal of, by synthetic resins, 1003
sodium; solutions of, survival of microorganisms in, 1000
Chlorination; algae control by, 1296, 1297
break-point; sterilization by, 1454
taste and odor control by, 1841, 1842
British practice in, 375
continuous; for protection against contamination of water by enemy action in wartime, 794
de-; influence of, on bacteriological investigation of water, 1000
determination and characterization of coliform bacteria from waters treated by, 1852
floc-forming organisms in water subjected to, 192
improvements in, 1624
presence of coliform bacteria in water after, 191
sterilization by, 1448, 1453, 1455, 2064
super-; sterilization by, 1448
waste water purification by, 1454
Chlorine; dangerous concentrations of, in air, automatic detection of, 1847
germicidal efficiency of; effect of pH on, 1453
measurement of, 1451
handling of, at water and sewage plants, 380
influence of, on hydrolytic action of pepsin, 192
precautions in transport and handling of, 381
solutions of, sterilizing quality of, under different conditions, 1453
Chlorophenol; *see* Phenol
Chloropicrin; colorimetric determination of small quantities of, in air, water and food, 1849
Chromates; inhibition of nitrification by, 1847
Citrate mutants; *see* Coliform bacteria

Clarification; accelerated; equipment for, 1845
Clarifiers; design of, 377, 378
silt removal by, 378
Clay; *see* Soils
Cleaning; main; increasing capacity by, 2066
Coagulation; aluminum sulfate; use of, in natural waters at low temperatures, 380
ferrous sulfate; treatment with, 1844
magno-iron sol; purification with, 1843
sodium silicate; 380
various types of, alkalinity and pH studies with, 1844
Coatings; galvanized zinc; standard methods for controlling thickness of, 1457
protective; effect of, on corrosion-fatigue strength of steel, 1460
Cocos; use of, in water works practice, 2063
Coli-aerogenes; see Coliform bacteria
Coliform bacteria; *Aer. aerogenes;* incidence of, in human fecal excreta, 192
observations on differentiation of, from *Esch. coli* on Levine's simplified E.M.B. agar, 997
antigenic relationships of, 188
citrate mutants; stability of, 998
detection of; lauryl sulfate tryptose broth in, 190, 996
methods for, 997
determination and characterization of, from chlorinated waters, 1852
ecology of, 193
Esch. coli; cultivation of, new enrichment methods for, 189
differentiation of, from *Aer. aerogenes* on Levine's simplified E.M.B. agar, 997
examination of supplies for, 996
incubation at 44°C. as a means of indicating presence of, 190
isolation of, from nut meats, comparative study of standard lactose broth and Eijkman medium for, 191
sensitivity of, to cold-shock, during logarithmic growth phase, 193
Esch. coli mutabile; lactase of, nature of, 997
fermentation of rare sugars by, biochemistry of, 193
incidence of; in chlorinated water, 191
in natural waters of Argentina, 192
in swimming pool water, 998
most probable numbers of, for evaluations of *Aer. aerogenes* tests by fermentation tube method, 187
spore formers; suppression of, in coliform isolation, 189
succinic acid formation by, relationship of carbon dioxide utilization to, 189
Collections; lenient policy of, advantages of, 1148
Colloids; organic; boiler feed water treatment with, advantages of, 1471
Color; comparison of, simple apparatus for, 990
removal of, treatment methods for, 374
two-component system of, colorimetric analysis of, 1006
Colorimetry; *see* Analysis
Combustion; submerged; development of, for recarbonation, 381
Comparator; color; simple construction of, 990
Compensation; Idaho Workman's Compensation Act; court decision on, for typhoid case, 179
laws on, for illness, 803
New Jersey Workman's Compensation Act; court decision on, for typhoid case, 1306
Concord, N. H.; water supply of, 1137
Concrete; *see also* Cement
control of, in masonry dam construction, 819
Condensers; red-brass; cathodic protection of, 813
refrigeration; corrosion control in, 812
Conditioning; 377 *ff.*, 1843 *ff.*
Conduits; outlet; cavitation in, of high dams, 825
Conferences; *see* Short schools
Conservation; water; problem of, in Grand Island, Neb., ground water supply, 200
recharge of underground supply for, 200
Construction; dam; 815 *ff.*
distribution system; 983 *ff.*, 2061 *ff.*
Consumption; data on; in Canada, 805
in hotels, 1132
increase of, for defense, 1615
Contamination; *see also* Pollution

bacterial; improbability of, as implement of war, 795, 1616
chlorination to prevent epidemic from, by enemy action during war, 794
ground water; factors in, 2075, 2076
Control; automatic; governors for, of steam turbines, 980
in pumping stations, 979
in well water treatment, 374
bacteriological; modern methods of, 1849
distribution system; by automatic valves, 987
filtration; modern methods of, 1832
rate-of-flow; improvement of filter operation with, 1837
Cooling systems; corrosion in, prevention of, 812
Copper; *see also* Pipe
colorimetric determination of, with triethanolamine, 1848
corrosion by, in hot-water systems, elimination of, 811
detection of small amounts of, in drinking water, 1005
influence of, with respect to corrosion in boilers, 370
occurrence of, in hot springs of Japan, 1005
services; manufacture and use of, 2070
sulfate; control of plankton by, 1297
Corrosion; 807 *ff.*, 1456 *ff.*
boiler; influence of copper in, 370
locomotive tube; causes and remedy of, 1473
Couplings; fibers for, 2063
Cracks; boiler; relationship of, to caustic embrittlement, 1472
Crenothrix; characteristics of, 194
Crustacea; control of, in water, 1298
Cultivation; aerobic; clear liquid medium for, of anaerobes, 999

D

Dams; 815 *ff.*
bombing of, 1616
Defense, 171 *ff.*, 779 *ff.*, 1125 *ff.*, 1271 *ff.*, 1612 *ff.*
Defiance, Ohio; break-point chlorination taste and odor control at, 1842
Density; current; relationship of, to cathodic protection, 1462
Dental caries; study of, including *L. acidophilus* estimations, 1298
Depreciation; regulatory aspects of, 1154
Design; boiler; mean temperature difference in, 1473
rational simplification of, 365
clarifier; application of experimental methods to, 377, 378
dam; masonry; basic assumptions of, 817
types of foundations used in, in Britain, 815
elevated tank; Charles Hawksley prize for, 985
filter; application of, to swimming pool system, 1837
trickling; factors in, 1835
gasoline pipe line; 1468
laboratory equipment; 988 *ff.*
pump; characteristic factors for, 976
swimming pool; outdoor; methods of, 1133
treatment plant; U. S. practice in, 1618
Diesel engines; *see* Power
Diffraction; x-ray; alumina floc study by, 1845
Dikes; use of, in reservoirs in Illinois, 1295
Dilution error; evaluation of, involved in estimating bacterial numbers by the plating method, 188
Disease; *see also* Health
application of employee compensation laws to, 179, 803, 1306
deaths from, data on, in Mexico, 1305
Dissolved oxygen; *see* Oxygen
Distilled water; survival of microorganisms in, 1000
Distribution error; evaluation of, involved in estimating bacterial numbers by the plating method, 188
Distribution systems; cathodic protection of, *see* Cathodic protection
construction of; 983 *ff.*, 2061 *ff.*
substitute materials for, 1273
extensions to; construction of, for army camps, 1131
flow in; *see* Flow
leakage in, prevention of, in wartime, 1615
maintenance of; 983 *ff.*, 2061 *ff.*
problems in, resulting from air raids, 1128
protection of, against air raids, 779
Dithizone; determination of small quantities of lead with, 1848

Dolomite; semicalcined; iron removal by, 1839
Drainage; basins; natural water loss in, 1291
of industrial premises, British legislation regarding, 1281
Drought; gastro-intestinal derangement during, 182
Dysentery; *see* Gastro-enteritis

E

Economy; office; standardization of business papers as a method of, 804
operating; achievement of, by better pump construction, 978
effect of electric operation on, 805
treatment; methods of, 1621
Edmonton, Alta.; softening at, 1841
Electricity; *see also* Power
A. C.; corrosion of iron electrodes by, in aqueous electrolytes, 814
effect of, on water pipes, 1460
currents; absence of, effect of, on corrosion of steel pipe in clay, 1459
1940 National Code on installations of, 805
operation by, economies of, 805
rationalization of, as a defense measure, 798
Electrolytes; aqueous; corrosion of iron electrodes in, by A.C., 814
Electrolytic processes; influence of, on development of chemical industries, 1448
Embrittlement; boiler; protection against, 372, 1472
caustic; relationship of, to cracks in boilers, 1472
relation of, to pitting and corrosion of locomotive tubes, 1473
Engineers; civil; work of, in defense, 1613
sanitary; functions of, in U. S. Army, 1306
water supply; organization of, in U. S. Army, 1613
England; *see* Britain
Enrichment; new methods of, for cultivation of *Esch. coli* and fecal streptococci, 189
Equipment; laboratory; 988 *ff.*
Ersatz materials; *see* Materials, substitute
Esch. coli; see Coliform bacteria
Euglenidae; limitations of, as polluted water indicators, 194
Evaporation; need for better data on, 1291

F

Fat refining industry; water technology in, 1147
Feed water; 365 *ff.*, 1470 *ff.*
improved supply of, at Shopton, Iowa, 1146
Fermentation; biochemical study of, of rare sugars, by coliform bacteria, 193
Fibers; use of, in water works practice, 2061
Filters; 387 *ff.*, 1832 *ff.*
construction of, substitute materials for, 1273
Filtration; 387 *ff.*, 1832 *ff.*
compact plant for, 1136
electro-automatic; combination of, with softening, in new British plant, 1626
equipment for, design of, 1619
Financing; 1151 *ff.*
Fire protection; emergency supplies for, for defense, 1615
experience with, during air raids in London, 1128
increased facilities for, in London, for defense, 1126
Fire sprinklers; effectiveness of, in London, during air raids, 1128
Fittings; *see* Pipe
Flax; use of, in water works practice, 2062
Floc; alumina; x-ray diffraction study of, 1845
formation of, from sodium aluminate, effect of water hardness on, 379
formers; study of, in chlorinated water supplies, 192
Flocculation; equipment for, design of, 1618
relation of, to sedimentation, 379
use of, before filtration, 389
Floods; 1287 *ff.*
Flow; *see also* Hydraulics
calculation of, in simple U-tube boiler, 365
friction in, in solder type fittings, 1469
ground water; 197 *ff.*, 2072 *ff.*

ABSTRACTS

measurement of, Allen salt-velocity method of, 1466
open-channel; measurement of, 1465
turbulence in, 1464
problems of, in hot-water systems, 1469
turbulent; application of, to metering, 1463
diffusive action of, in open channels 1464
types of, for muds, sludges and suspensions in circular pipe, 1465
viscous; application of, to metering, 1463
Flowmeter; capillary; design of, 989
Fluorides; estimation of, 1004
occurrence of, in food and drinking water, 179, 1300
pathological aspects and treatment of, in waters, 180
water- and food-ingested, comparison of effects of, 1300
Fluorine; amperometric titration of, with thorium nitrate, 1004
analysis of, in water, 1004
effect of, on dental enamel, 181
elimination of, from drinking water, 1004
menace of, to health, 181
occurrence of; in drinking water of New Mexico, 181
in ground waters of the Khibin Region, 2076
in some Hungarian waters, 181
removal of, from domestic water, experiments on, 1299, 1300, 1301, 1622
traces of, significance of, 1299
Fluorosis; dental; occurrence of, in Mexico, 181
endemic; bone changes in, 1299
chronic; occurrence of, in northern India, 1301
occurrence of, in South India, 182
Food; colorimetric determination of small quantities of chloropicrin in, 1849
fluorides in, 179
handling of, transmission of amebiasis through, 182
staphylococcal poisoning in, third outbreak of, in Hamilton, Ont., 182
Foundations; dam; examples of, in British practice, 815
masonry; preparation of, 817
Free water; authority for provision of, in Ohio, 1158
Freshwater Biological Association of the British Empire; eighth annual report of, 185
Friction; utilization of, as an indicator in titration, 995
Frost penetration; damage to distribution systems by, 987, 2065
depth of, under pavement, 986
permanent; maintenance of service in distribution systems subjected to, 986
protection of meters and services from damage by, 2069
studies on, 986

G

Garbage disposal; sanitary land fills for, 176
Gas; flue; corrosion of metals and alloys by, 814
formers; problem and significance of, 191
liquors; phenol recovery from, in Germany, 1286
mustard; toxicological investigations of waters containing, 796
poison; detection and determination of, in drinking water, 1277
production of, variation in, by *Aerobacter clocae*, 998
toxic; detection of, in industry, 1010
Gastro-enteritis; amebiasis; transmission of, by food handlers, 182
dysentery; outbreak of, due to stream pollution, 182
occurrence of, during drought, 182
study of, bacteriological techniques in, 1850
Generators; electric; steam-turbine-driven; lubrication of, 981
Geology; methods of, for ground water determinations, 2074
problems of, in regard to masonry dams, 818
Germany; air raid protection measures in, 787
rural supplies of; extension and safeguarding of, 1141
water supplies of, future trends in, 1140

Girders; precast; use of, for roof of filtered water reservoir, 984
Glucosates; feed water treatment with, 371
Goiter; endemic; incidence of, related to soil and fresh-water content of iodine, in Ireland, 1304
Government; regulation by; *see* Regulation
U. S.; activities of, for control of river pollution, 1277
Governors; steam-turbine; automatic control by, 980
Grand Rapids, Mich.; meter practice at 2071
Graphical calculation; determination of softening conditions of water by, 1837
Gravity filters; general data on, 390
Gray's Harbor, Wash.; pollution in, occurrence and cause of, 1283
Great Britain; *see* Britain
Green Bay, Wis.; pollution in vicinity of, investigation of, 1281
Greenhouses; water conditioning for, 383
Ground water; 197 *ff.*, 2072 *ff.*; *see also* Wells
Grouting; importance of, in well construction, 2076
Guelph, Ont.; 1940 annual report of water works at, 1140

ABSTRACTS

H

Hallock, Minn.; new treatment plant at, 1625
Hardness; *see also* Softening
effect of, on formation of floc from sodium aluminate, 379
magnesium; removal of, 387
Hardy Cross method; application of, to distribution problem, 1469
Hazards; *see also* Safety
employee; analysis of, as cause of accidents, 804
electric and gas welding as, 803
Head; loss of, determination of, in uniformly tapped pipes, 1468
Health, 174 *ff.*, 1298 *ff.*; *see also* Disease
meetings; better planning for, 176
Heating systems; *see* Hot-water systems
Hemp; use of, in water works practice, 2062
Herbicide; benochlor-3; use of, to control aquatic vegetation, 1296
Hexametaphosphate; *see* Sodium hexametaphosphate
Holidays; detection of, improved equipment for, 815
Holland; *see* Netherlands
Hotels; water supply problems in, 1132
Hot-water systems; change of zinc potential in, 812
corrosion in; elimination of, caused by copper, 811
prevention of, 1461
problems of, 811
flow problems in, 1469
Houston, Tex.; meter testing and maintenance at, 2071
Hudson River; lower; watershed of, pollution of, 1284
Humidity; effect of, on corrosive activity of soils, 809
Hurricane; floods caused by, in September 1938, 1290
Hydraulics; 1463 *ff.*
Hydrogen ion concentration; *see* pH
Hydrology; 1287 *ff.*
Hydrolytic action; influence of chlorine, sodium hypochlorite and iodine on, 192
Hygiene, 174 *ff.*, 1298 *ff.*
Hypochlorite; *see* Calcium, Sodium

I

Illinois; water problems in, solution of, by dike reservoirs, 1295
Immunization; efficacy of, in acute outbreak of typhoid, 177
Impounding reservoirs; *see* Reservoirs
Incrustation; tufaceous; deposit of, on sand strainer in borehole for water, 809
Incubation; 44°C.; indicating presence of *Esch. coli* by, 190
Indiana; stream pollution control in, 1280
Industrial water supply; *see* Supply
Infantile paralysis; *see* Poliomyelitis
Infiltration; vertical; ground water; significance of, for protective zones, 2074
Inflation; probable effect of, on utilities, 1148

Insurance; mutual; contingent liability under, 1155
Intercrystalline cracks; occurrence of, in locomotive boilers, 372
Iodide; mercuric; recovery of, from Nesslerized solutions, 1847
Iodine; content of, in soil and fresh water, in Ireland, 1304
influence of, on hydrolytic action of pepsin, 192
recovery of, from Nesslerized solutions, 1847
Ireland; northern; water supply in, 1141
Iron; *see also* Mains
bacteria; characteristics of, 194
colorimetric determination of, with salicylaldoxime, 1006
corrosion of; effect of small concentrations of sodium silicate on, 811
influence of low concentrations of sodium silicate on, 1459
electrodes; corrosion of, by A.C. in aqueous electrolytes, 814
galvanized; tarnish and corrosion on, 815
removal of; 382 *ff.*, 1837 *ff.*
Irrigation; general practices in, in western states, 1133
Isolation; bacilli; typhoid and paratyphoid; simple modification of the Wilson and Blair medium for, 999
Esch. coli; comparative study of standard lactose broth and Eijkman medium for, from nut meats, 191
Italy; Apulian water system of, 1144
army; methods of water supply for, 799
water works practice in, effect of war on, 1616

J

Japan; copper, lead and zinc content of hot springs of, 1005
Jewell brothers; work of, in mechanical filtration, 1833
Joints; *see also* Pipe
bell and spigot; comparative tests on, 984
construction; types of, in masonry dams, 819
fibers for, 2061
substitute materials for, 2064
Jute; use of, in water works practice, 2062

L

Labor policy; five-day week; extent of, in city employment, 804
Laboratory methods—equipment and apparatus; 988 *ff.*
Lactase; *Esch. coli mutabile;* nature of, 997
L. acidophilus; estimations of, inclusion of, in study of dental caries, 1298
Lactose fermenters; slow; incidence of, in water supplies, 190
Lake Erie; western; limnological study of, 1297
Land values; relation of planning and housing to, in U. S., 1150
Larvae; mosquito; control of, in water, 1298
Law; *see also* Legal decisions
compensation; application of, to employee illness, 179, 803, 1306
relation of, to water rates, 1158, 1159, 1160
technicalities of, on rights of riparian owners, 806
Lead; *see also* Pipe, Services
basophilia from water containing, 183
detection of small amounts of, in drinking water, 1005
determination of small quantities of, with dithizone, 1848
estimation of, in drinking water, 1005
occurrence of, in hot springs of Japan, 1005
pipe; behavior of, in field, 2069
poisoning; non-industrial; observations on, 1304
solution of, in drinking water, 183
Leaks; *see* Mains, Pipe, Plumbing
Legal; concepts; analysis of, of subflow and percolating waters, 198, 2077
decisions; bathing; regulation prohibiting, on impounding reservoir upheld by, in New Hampshire, 175
pollution; damages for injuries due to, granted by, in Mississippi, 182
sanitary tax in connection with privies upheld by, in South Carolina, 177
typhoid; compensation for, under workmen's compensation acts, 179, 1306
Licensing; employee; benefits of, 802

short schools as an aid in, 802
Lighting; street; methods of, during blackouts, 797
Lime; corrosion control with, in Biddeford, Me., 808
sterilization with, 1451
treatment with, 1843
Lime-soda softening; theoretical limits of, 385
use of; in Granite Falls, Minn., 386
in Ypsilanti, Mich., 385
with Spaulding precipitators, 384
Limnology; *see* Algae
Lindsay, Ont.; improvement of filter operation in, with rate-of-flow controllers, 1837
Little Rock, Ark.; 1939 annual report of water works at, 1137
Liverpool, England; billeting of civilians in, 1129
Logarithmic growth; bacterial; cold-shock during, sensitivity of *Esch. coli* to, 193
London, England; fire brigade of, 1125
London, Ont.; 1939 annual report of water works at, 1140
Los Angeles; Major Disaster Emergency Council of; organization of, for defense, 1614
Louiseville, Que.; new sources of supply for, 1139
Lubrication; systems of, for steam-turbine-driven electric generators, 981

M

Magnesium; hardness; removal of, 387
salts of, determination of dissolved oxygen in presence of, 1846
Magno-iron sol; coagulation with, 1842
Magnomass; iron removal by, 1839
Mains; *see also* Distribution systems, Pipe
cast-iron; age of, in Canada, 2066
cleaning of, *see* Cleaning
cost of, estimation of, 983
maintenance of, use of oxy-acetylene equipment for, 984
new; sterilization of, 1456
repair of; internal sleeving for, 2066
sterilization practice in, in Britain, 792
six-inch; cost of, in Canada, 2065
welding of, automatic methods of, 984
Maintenance; distribution system; 983 *ff.*, 2061 *ff.*
precautions for, against air raid damage, 172, 173, 782
problems in, resulting from air raids, 1128
valve insertion for, in mains under pressure, 173
filter; methods of, 1835
main; sterilization practice in, in Britain, 792
meter; 2068 *ff.*
reservoir; methods of, after bombing, 1276
water system; methods of, during air raids, 782
Management; *see* Administration
Manganese; colorimetric; determination of base-exchange capacity of soils and other materials by, 1004
Maps; *see* Records
Marietta, Ohio; treatment methods at, 1624
Maryland State Department of Health; 1940 annual report of, 1306
Masonry; use of, in dam construction, 817
Materials; availability of, for water works reconstruction in Netherlands, 1131
steam-boiler; damage of, from overheating in construction, 1472
substitute; application of, in distribution systems, 2064
use of, in German water supplies, 1271
Media; brilliant green bile; comparison of, with lactose broth, 191
detection of coliform organisms by, 997
clear liquid; aerobic cultivation of anaerobes with, 999
Eijkman; comparison of, with standard lactose broth for isolation of *Esch. coli* from nut meats, 191
eosin methylene blue agar; Levine's simplification of; observations on differentiation of *Esch. coli* and *Aer. aerogenes* on, 997
lactose broth; comparison of, with brilliant green bile, 191

standard; comparison of, with Eijkman medium for isolation of *Esch. coli* from nut meats, 191
lauryl sulfate tryptose broth; detection of coliform organisms by, 996
sodium lauryl sulfate lactose tryptose broth; use of, as primary medium for detection of coliform group, 190
Wilson and Blair; simple modification of, for isolation of typhoid and paratyphoid bacilli, 999
use of, in public health work, 178
Mercury; detection of small amounts of, in drinking water, 1005
Metals; by-product coke industry; corrosion tests on, 813
corrosion of; *see also* Corrosion
by flue gases, 814
by soils, 808
relationship of, with microbiological processes, 1457
galvanized; corrosion of; controlling factors in, 1457
potentials of, in sea water, 1458
Metaphosphate; *see* Sodium hexametaphosphate
Metering; application of viscous and turbulent flow to, 1463
Meters; 2068 *ff.*
relation of, to rates, 1158
substitute materials for, 1274
Venturi; novel construction of, 2067
Mexico; principal causes of death in, 1305
Microbiology; processes of, relationship of, to corrosion of metals, 1457
Micro-organisms; survival of, in sodium chloride solutions and in distilled water, 1000
Mineral waters; conductimetric determination of salts in, 1002
Mixing; equipment for; design of, 1618
Moonlight; influence of, on photosynthesis in fresh water algae, 1298
Moose Jaw, Sask.; river supply for, 1139
Most probable number; estimation of, by microscopic method, 188
evaluation of *Aer. aerogenes* tests with, by fermentation tube method, 187
evaluation of errors involved in estimation of, by plating method, 188
use of, in bacteriology, 999
Motors; drying of, when flooded, 982
Muds; flow of, in circular pipe, 1465
oxidation reduction potentials in, 1846
stream sampling in, devices for, 992
suspensions of; determination of B.O.D. and D.O. of, 1000
Mundaring Reservoir; safe yield from, 1295
Municipal ownership; employee morale under, 1149
five-day week under, 804
management problems under, 801, 1134
taxes under, in Canada, unfair exemption from, 1149
Mustard gas; toxicological investigations of waters containing, 796

N

Natural waters; carbon dioxide removal from, 1846
oxidation reduction potentials in, 1846
Nessler; *see* Reaction, Reagent, Tubes
Netherlands; materials available for reconstruction of water works in, 1131
water supplies in, 1143
New York City; fire department of, 1125
New York Public Service Commission; rules of, for water works corporations, 2068
Newmarket, Ont.; deep well supply of, 2078
Nitrate; silver; reclaimed crystals of, washing of, with alcohol, leads to explosion, 1009
thorium; amperometric titration of fluorine with, 1004
Nitrification; inhibition of, by chromates, 1847
Nitrite; azo-xylidic reagent for determination of, 1008
colorimetric determination of, 1008
nitrogen; determination of, standards for, 1008
reaction of, with hypochlorite ion, 1847
Nitrogen; colorimetric estimation of, with Nessler reagent, sources of error in, 1847
compounds of, regeneration of, in decomposition of dead plankton, 1297
nitrite; determination of, standards for, 1008
photometric determination of, application of Nessler reaction to, 1001
Northern Pacific R.R.; deep well supply of, 2079

O

Oak Park, Ill.; servicing and testing meters at, 2070
Odors; control of, 1841 *ff.*
Office practice; standardization of business papers in, 804
Ogden River project; artesian versus surface supply for, 2077
Ohio River Valley Water Sanitation Compact; progress in adoption of, 175
Oil; lubricating; effect of, in boilers, 1472
Open-channel flow; *see* Flow
Operation; effect of war on, 1615, 1617
Orifices; circular; small; discharge and coefficients of, 1469
Owensboro, Ky.; softening at, 1840
Oxidation reduction potential; in waterlogged soils, natural waters and muds, 1846
relationship of, to measurement of germicidal efficiency of chlorine, 1451
Oxygen; consumption; influence on, by bacteria in water, 195
dissolved; determination of, in river mud suspensions, 1000
determination of, in solutions, 1846
colorimetric estimation of, 1845
influence of, on corrosion by refrigeration brines, 812
sampling devices for, 991
Ozone; analysis of, by starch-iodide method, 1007
commercial; properties and manufacture of, 375
sterilization by, 1448, 1450
treatment by, 376

P

Packing; centrifugal pump; 978
Paint; non-corrosive; steel work protection with, 1460
protective value of, methods of determining, 808
Paper industry; first bleached sulfite mill of, in South, 1145
water requirements of, 1145
Paralysis, infantile; *see* Poliomyelitis
Paratyphoid; *see* Typhoid
Penns Grove, N. J.; radial well water system at, 2078
Pepsin; hydrolytic action of, influence of chlorine, sodium hypochlorite and iodine on, 192
Peptones; chemical and bacteriological studies of, 1851
preparation of, by enzymic digestion of casein, 1851
Personnel; 802 *ff.*, 1147 *ff.*; *see also* Short schools
effect of war on, 1617
efficiency of, in maintenance practice in wartime, 791
utility; effect of war on supply of, 1614
Petroleum industry; use of water in, 1146
pH; determination of, 1001
effect of, on germicidal efficiency of chlorine, 1453
influence of, on corrosion by refrigeration brines, 812
study of, with various coagulants, 1844
Phenol; chloro-; taste; prevention of, with ammonia, carbon and breakpoint chlorination, 1842
ground water flow determination with, 2074
recovery of, from waste gas liquors, 1286
waste; filtration of, through soil for purification, 1835
Phosphate; colorimetric determination of, 1002
feed water treatment with, 371
hexameta-; *see* Sodium hexametaphosphate
liquors; recovery of tin from, 1287
poly-; softening with, 1838
tri-; calcium complexes of, 1848
trisodium; system; properties of, 1002
Phosphorus; compounds of, regeneration of, in decomposition of dead plankton, 1297
Photosynthesis; influence of moonlight on, in fresh water algae, 1298
Phytoplankton; *see* Plankton
Pipe; *see also* Distribution systems, Mains, Services
circular; flow of muds, sludges and suspensions in, 1465
cleaning of, *see* Cleaning
copper; corrosion of, 1458
economic size of, 983
fittings; copper; manufacture and use of, 2070

solder type; friction of fluids in, 1469
gasoline distribution; design and construction of, 1468
hot-water; internal corrosion of, inhibition of, 1461
lead; behavior of, in field, 2069
corrosion of, effect of various inorganic salts on, 1459
leaks in; repair of, by plugging with "jelly," 2066
natural-gas; cathodic protection of, 813
pressure; cast-iron; modern engineering practice in, 983
protection of, fibers for, 2063
service; materials used in, 2069
sizes of, standards for calculation of, for house installations, 2068
steel; cathodic protection of, use of zinc for, 812
corrosion of, in water, in absence of electric currents, 1459
underground; cathodic protection of, 813
sub-stream; floating into place of, 2066
underground; corrosion of, methods for control of, 1459
uniformly tapped; head-loss determination in, 1468
Pitting; locomotive tube; causes and remedy of, 1473
Plankton; *see also* Algae
chemical composition of, 1297
control of, by copper sulfate and chlorine, 1297
dead; decomposition of, regeneration of nitrogen and phosphorus compounds in, 1297
mass development of, in Uchinskiĭ Reservoir, 1298
phyto-; occurrence of, in California waters, 1296
production of, effect of carbonate on, 1297
Plumbing; leaks in, systematic check-up on, 2068
Poisoning; sulfur dioxide; asthma caused by, 184
water; causes and prevention of, 184
detection and determination of, 1277
Poliomyelitis; fecal examination in, observations on, 1303
virus of; in stools and sewage, 1304
survival of, in sewer water, 183
Pollution; *see also* Contamination
ground water; chemicals as a cause of, 2075
indication of, limitations of Euglenidae in, 194
stream; 1277 *ff.*
dysentery outbreak caused by, 182
survey of, mechanical aids to, 991
Polyphosphate; *see* Phosphate
Ponds; dissolved carbon dioxide in, micro-determination of, 1847
Portland acid; boiler cleaning with, 1473
Potentiometer; portable; use of, in cathodic protection surveys, 812
Powders; average particle diameter of, measurement of, 994
Power; diesel; economies of, in pumping stations, 979
for pump drives, 979
for transportable emergency pumping sets, 979
economy of, use of elevated tanks for, 985
electric; *see also* Electricity
for deep well pumping units, 982
generators for, lubrication of, 981
necessity for protection of, during wartime, 797
Precipitators; Spaulding; experiences with, in cold lime-soda softening, 384
horizontal type; use of, at Marietta, Ohio, 1624
Pressure; high; progress of, in industrial plants, 1473
Privies; sanitary tax in connection with, upheld by legal decision in South Carolina, 177
Protozoa; rôle of, in self-purification of streams, 187
Providence, R. I.; improvements to treatment plant at, 1624
Public ownership; *see* Municipal ownership
Public relations; 807 *ff.*, 1147 *ff.*
Public Works Administration; projects under, in Maine water works, 1137
Pumping stations; protection of, against air raids, 780
Pumps; 976 *ff.*
trailer; use of, in London, for fire protection, 1126

Purification; *see also* Treatment
functions of bacteria in, 185
magno-iron sol coagulation in, 1843
present trends in, 1620
self-; rôle of protozoa and bacteriophages in, 187

Q

Quality; 195 *ff.*
bacterial; control of, 1849
interpretation of, 1850
boiler feed water; relation of, to composition of boiler scale, 369
chemical; changes in, in sand filters, 1835
effect of accelerated filtration on, 1833
hygienic determination of, criticism of methods for, 1305
Quincy, Ill.; 1939 annual report of water works at, 1137

R

Radial wells; water system based on, 2078
Rainfall; *see also* Hydrology
analysis of, for 60-year period, 1289
measurements of, use of, in surface runoff determinations, 1289
station-year frequency determinations of, reliability of, 1287
Rameh; use of, in water works practice, 2062
Rates; 1156 *ff.*
Reaction; Nessler; relation of, to effect of temperature on colorimetric determinations, 1847
stability of, and application to photometric determination of nitrogen, 1001
Reagent; azo-xylidic; determination of nitrites with, 1008
Nessler; colorimetric estimation of nitrogen with, sources of error in, 1847
preparation of, 1001
use of, in recovery of mercuric iodide and iodine, 1847
Recarbonation; submerged combustion for, 381
Reconstruction; post-war; materials available for, in Netherlands, 1131
plans for, in Britain, 1617
Records; distribution system; importance of, 984
preparation of maps for, 2065
use of, in maintenance, 983
service box; system for, 2069
Refrigeration systems; corrosion in, prevention of, 812
Regulation; government; London fire brigade hampered by, in defense, 1127
New York Public Service Commission; rules of, for water works corporations, 2068
relation of depreciation to, 1154
use of expert on, to assist in management, 801
utility; relationship of, to defense, 1131
Repair; *see* Maintenance
Reports; financial; simplification of, 1152
Reservoirs; filtered water; use of precast supports and girders for roof of, 984
impounding; 1294 *ff.*
protection of, against air raids, 780
regulation against bathing on, upheld by court, 175
reinforced concrete; repairs to, after bombing, 1276
Resins; synthetic; removal of chlorides and sulfates with, 1003
Resistivity; electrical; use of, in apparatus for testing well waters, 988
Resources; water; summary of, for Mid-Continent area, 1287
Riparian owners; legal technicalities on rights of, 806
Ruhr District; ground water conditions in, 2074
Runoff; surface; determinations of, from rainfall, without using coefficients, 1289
Rural supplies; extension and safeguarding of, in Germany, 1141
Russia; maintenance of service in distribution systems in, in permanently frozen ground, 986

S

Sabotage; considerations in protection against, 171
danger of, of wells, 172
measures against, in New Haven, Conn., 1131
Safety; *see also* Hazards

measures for, in handling of chlorine, 380, 381
Salicylaldoxime; colorimetric determination of iron with, 1006
Salts; conductimetric determination of, in mineral waters, 1002
contamination of ground water by, 2076
deposits of, in steam turbines, 367
dissolved; filtration of, effect of, in sand filtration, 1834
inorganic; effect of, on corrosion of lead pipes, 1459
magnesium; determination of, dissolved oxygen in the presence of, 1846
removal of, by synthetic zeolites, 386
savings in, by brine reclamation in zeolite plants, 1839
Sampling; bacteriological; avoiding errors in, 1850
vibration in, effect of, on bacterial counts, 1852
stream; mechanical devices for, 991
Sand; *see also* Filtration
blasting; cleaning of meter casings by, 2071
granulometric composition of, precise determination of, 994
hydraulic transportation of, in refilling slow sand filters, 1834
removal of, from well water, 2076
Sanitation; problems of, resulting from air raids, 1128
Scale; boiler; analysis of, 368
composition of, in relation to quality of boiler feed water, 369
formation of, use of x-ray to identify deposits involved in, 369
inhibition of, by boiler compounds, 370
removal of, by chemical means, 369
silicate; occurrence and correction of, in high pressure boilers, 366
calcium silicate; phases in, identification of, 1471
formation of, tendency of water toward, measurement of, by short-time tests, 1456
Schools; *see* Short schools
Scotland; water supply of, 1141
Sea water; pollution of, by discharge of sewage, 1284
potentials of metals and alloys in, 1458
Sedimentation, 377 *ff.*, 1843 *ff*
equipment for; design of, 1618
Selenosis; chronic; studies of, 1301
Self-purification; rôle of protozoa and bacteriophages in, 187
Service; extensions to, beyond city limits, 1157
interruptions to, minimization of, by extra valves, 2067
maintenance of, in permanently frozen ground, 986
Services; 2068 *ff.*; *see also* Pipe
effect of A.C. on, 1460
substitute materials for, 1274
Settling tanks; sludge blanket type; operation of, in Ohio, 380
Sewage; discharge of, pollution of sea water by, 1284
disposal of; *see also* Garbage
methods of, at army camps, 174, 800
effluent; sterilization of, by chlorine, 1454
straining of, 1832
virus of poliomyelitis in, 183, 1304
Shanghai, China; 1939 annual report of water works of, 1144
Shopton, Iowa; improved boiler feed water supply at, 1146
Short schools; use of, in connection with licensing and certification, 802
water works advancement through, in the Southwest, 802
Silica; deposits of, in steam turbines, 367
occurrence of, in boiler feed water, 367
removal of; from boiler feed water, 1470
from industrial water supplies, 1145
from water, 367, 1470, 1471
scales of, occurrence and correction of, in high pressure boilers, 366
Silicate; sodium; *see* Sodium silicate
Silicic acid; removal of, from boiler feed water, 368
significance of, in operation of high pressure boilers, 368
Silt; removal of, by clarification, 378
Silver nitrate; reclaimed crystals of, washing of, with alcohol, leads to explosion, 1009
Singapore; water supply of, 1144
Sisal; use of, in water works practice, 2063

Sleeving; internal; main repair by, 2066
Slide rule; design of, for water technology calculations, 988
Sludge; boiler; method for analysis of, 368
flow of, in circular pipe, 1465
Sludge blanket settling tanks; operation of, in Ohio, 380
Sluice gates; large; model tests of, at high velocities of approach and with different pier noses, 825
Soap; savings in, softening in relation to, 1839
Sodium; aluminate; formation of floc from, effect of water hardness on, 379
chloride; solutions of; survival of micro-organisms in, 1000
hexametaphosphate; calcium complexes of, 1848
corrosion control with, 808, 1461
experiences with, 1621
inhibiting action of minute amounts of, on precipitation of calcium carbonate from ammoniacal solutions, 1002
softening with, 376, 1838
hypochlorite; influence of, on hydrolytic action of pepsin, 192
silicate; dosing with, to aid coagulation, 380
low concentrations of, influence of, on corrosion of iron in water, 811, 1459
thiosulfate; stable solutions of, preparation of, 1003
tri-; phosphate; system; properties of, 1002
Softening; 382 *ff.*, 1832 *ff.*; *see also* Hardness
compact plant for, 1136
electro-automatic; combination of, with filtration, in new British plant, 1626
lime-soda; cold process; silica removal by, 1470
hot process; silica removal by, 1471
Soils; base-exchange capacity of, determination of, using colorimetric manganese method, 1004
corrosion by; effect of humidity on, 809
effect of, on metals and cement products, 808
investigation of, on Baku-Batum pipe line, 809
investigation of, with respect to exterior of pipes, 809
filtration through, treatment of phenol waste waters by, 1835
natural and artificial layers of, amount of flow and physical phenomena in, 2073
permanently frozen; maintenance of service in distribution systems in, 986
water-logged; oxidation reduction potentials in, 1846
Solids; dissolved; determination of, by evaporation method, in condensed boiler steam, 1473
granular; pumping of, in fluid suspension, 976
Spaulding precipitators; *see* Precipitators
Speed; specific; influence of, on design of pumps and turbines, 977
terminal; calculation of, 1467
Sprinklers; fire; effectiveness of, in London, during air raids, 1128
lawn; discriminatory rates for, 1157
Standpipes; design of, 985
inward collapse of, 985
Starch-iodide method; use of, in ozone analysis, 1007
Statistics; hydrologic; curve of concentration in, 1292
Steam; boiler; condensed; dissolved solids in, determination of, by evaporation method, 1473
circulation of, in water-tube boilers, 365
sampling of, to detect corrosion, 1456
Steel; *see also* Pipe, Mains, Tanks
corrosion-fatigue strength of, effect of protective coatings on, 1460
nickel and copper alloy; atmospheric durability of, 1457
protection of, with non-corrosive paint, 1460
Sterilization; 1448 *ff.*; *see also* Chlorination
main; methods of, to prevent pollution after repairs, 792, 2064
practical methods for, of water consumed by evacuées, 794
Storage; use of, to aid treatment, 378
Streams; pollution in, *see* Pollution
tularaemia infection found in, 183
Streptococci; fecal; cultivation of, new enrichment methods for, 189

occurrence of, in swimming pool water, 998
Succinic acid; formation of, by coliform bacteria, relationship of, to carbon dioxide utilization, 189
Sugars; rare; fermentation of, by coliform bacteria, biochemical study of, 193
Sulfates; removal of, by synthetic resins, 1003
Sulfite waste liquors; nitrosolignin colorimetric tests for, 1003
treatment and disposal of, 1285
Sulfur; burner; feed water treatment with, 371, 1472
compounds of, treatment with, 1623
production of, water problems in, 1147
Superheaters; steam; use of, in water-tube boilers, 366
Supersonic waves; purification by, 373
Supply; 1132 *ff.*
adequacy of, in London, during war, 796
cost of, in Canada, data on, 805
effect of war on, 799
emergency; provision of, for defense, 1615
industrial; 1145 *ff.*
powder plant; radial wells for, 1616
methods of, for army and army airports, 173, 174
methods of, in Italian Army, 799
protection of, against air raids, 779
sanitary report on, for army posts, 175
Surpluses; disposition of, 1156
Suspensions; flow of, in circular pipe, 1465
fluid; pumping of granular solids in, 976
mud; determination of B.O.D. and D.O. of, 1000
Swimming pools; coliform bacteria and streptococci in, 998
filtration system for, design and operation of, 1837
indoor; bacteriological survey of, in Quebec, 195
outdoor; design and construction of, 1133
purification and heating of water for, 1625
standards and regulations for water quality in, 195
treatment of water for, 375
Switzerland; water supply of, 1144
Sydney, New South Wales; Warragamba water scheme in, 1142

T

Tanks; *see also* Distribution systems
elevated; design of, 985
moving of, by tractors, 2067
power economy by use of, 985
oil storage; cathodic protection of bottoms of, 813
seating of, use of ice cakes for, 2067
steel; cathodic protection of, 813
Tastes; control of, 1841 *ff.*
Taxes; exemption from, discrimination in, in Canadian publicly owned utilities, 1149
expenditure of moneys from, data on, 806
sanitary; levying of, in connection with privies, upheld in South Carolina, 177
Technology; calculations of, slide rule for, 988
Teeth; *see* Caries, Fluorides, Fluorine, Fluorosis, Health
Temperature; effect of, on filter operation, 389
importance of, for colorimetric determinations, 1847
variation in, effect of, on softening reactions in laboratory samples, 1838
Tennessee Department of Public Health; 1937–39 report of, 1305
Textile industry; water for, in Germany, 1146
Thawing; *see* Frost penetration
Thiosulfate; sodium; stable solutions of, preparation of, 1003
Thorium nitrate; amperometric titration of fluorine with, 1004
Threshold odor; old and new tests for, 1841
Tin; recovery of, from waste phosphate liquors, 1287
Tirso Dam, Italy; bombing of, 1616
Titanium; determination of traces of, in natural waters, 1007
Titration; amperometric; fluorine determination by, with thorium nitrate, 1004
friction as indicator of, 995
starch-iodide and ortho-tolidine; rela-

tionship of, to measurement of germicidal efficiency of chlorine, 1451
Tornado; water works operation during, 1134
Toronto, Ont.; drifting and slow sand filters at, 1834
improved chlorination methods at, 1624
Transportation; hydraulic; application of, to refilling slow sand filters, 1834
Treatment; 372 *ff.*, 1618 *ff.*; *see also* Purification
corrosion control; methods of, 807
feed water; 365 *ff.*, 1470 *ff.*
methods of, for small town supply, 1136
waste water; phenolic; soil filtration for, 1835
well water; automatic control of, 374
Triethanolamine; colorimetric determination of copper with, 1848
Trisodium phosphate; system; properties of, 1002
Tubes; *see also* Pipe
Nessler; support for, design of, 989
Tucson, Ariz.; water works improvement at, 1136
Tularaemia; causative organism of, found in streams, 183
Turbidity; reduction of, by storage, 378
Turbines; foundations for, experimental and theoretical investigation of, 980
Kaplan; development of, 979
specific speed of, 977
steam; governors for, 980
portable; emergency service in wartime with, 796
salt and silica deposits in, 367
Turbulent flow; *see* Flow
Tygart Reservoir; operation experiences at, 1294
Tyler, Tex.; operation of treatment plant at, 1625
Typhoid; bacilli of; isolation of, simple modification of the Wilson and Blair medium for, 999
carriers; spread of disease by, 177
compensation for under Workman's Compensation Act; denied, in Idaho, 179
granted, in New Jersey, 1306
epidemic; associated with a trailer camp, 1303
at Montreal, 1303
immunization against, efficacy of, 177, 1302
outbreak; 53 deaths from, in Manteno, Ill., 178
in Linares, Chile, 178
in the Philippines, 178
water suspected as cause of, in Illinois, 178
paratyphoid; bacilli of; isolation of, simple modification of the Wilson and Blair medium for, 999
paratyphoid-B-Schottmuller; small epidemic of, in Germany, 179

U

Uchinskiĭ Reservoir; blooming of, 1298
Ultra-violet rays; irradiation by, sterilization by, 1451
Underdrainage; principles of, as applied to ground water in engineering works, 2072
U. S. Public Health Service; historical review of work of, 174
Ohio River Pollution Survey; bacteriological techniques of, in study of gastro-enteritis, 1851
first year's work of, 1280, 1281
research of, in stream pollution, 1278, 1280, 1281
stream surveys of, mechanical aids to, 991
Urinary calculi; discussion of, 184
Utah; submerged well field supply in, 2077
Utilities; effect of war on, 799, 1614

V

Valves; *see also* Distribution systems
automatic; control by, 987
float; automatic; use of, in Rangoon water supply, 988
insertion of, in mains under pressure, 173
minimizing service interruptions with, 2067
pressure-reducing; operation of, in distribution systems, 988
Vanadium; quantitative determination of, new method for, 1006

Variability; implications of, on species concept in bacteriology, 186
Vegetation; aquatic; control of, 1296
Viscous flow; *see* Flow

W

Warragamba water scheme; development of, 1142
Washing; surface; filter; experiences with, 1836
Wastage; water; prevention of, in wartime, 1615
Wastes; industrial; pollution by, British legislation against, 1281
purification of by chlorine, 1454
treatment and control of, 1284, 1285
treatment of, recovery of materials in, 1285, 1286, 1287
oil field; disposal of, 1284
phenolic; filtration of, through soil for purification, 1835
Welding; automatic; use of, in mains, 984
hazards of, to workmen, 803
Welland, Ont.; 1940 annual report of water works at, 1140
Wells; 197 *ff.*, 2072 *ff.*
army camp supply from, 1617
construction of, substitute materials for, 1271
danger of sabotage of, 172
deep; pumping units for, at Wingham, Ont., 982
radial; powder plant supply from, 1616
testing in; electrical resistivity apparatus for, 988
West Lorne, Ont.; water supply of, problems in, 1139
Wilson and Blair medium; *see* Media
Workmen's Compensation Act; *see* Compensation

X

X-ray; diffraction study of alumina floc by, 1845
identification of types of scale-forming deposits by, 369

Y

Youghiogheny River; reservoir project on, 1295
Yperite; toxicological investigations of waters containing, 796
Ypsilanti, Mich.; softening at, 1840

Z

Zagreb, Germany; meter practice at, 2071
Zeolites; recent improvements in, 1838
softening by; in East Lansing, Mich., 386
reducing salt consumption in, by brine reclamation, 1839
synthetic; salt removal by, 386
treatment for chemical impurities with, 1621
Zinc; anti-corrosiveness of, 1457
determination of traces of, in biological material and in natural waters, 1006
galvanized; coatings of, standard methods for controlling thickness of, 1457
occurrence of, in hot springs of Japan, 1005
potential; change of, in hot-water systems, 812
rôle of, in cathodic protection of steel pipes, 812

Authors of Abstracted Articles

Abramson, D. S., 1457
Adams, M. P., 1284
Adams, R. B., 1852
Aldama, C. A., 1305
Alexander, L. J., 1840
Allen, W. E., 1296
Allman, L. W., 1136
Allport, N. L., 1006
Alyea, H. N., 989
Alzamora, F. C., 1009
Ammer, G., 371
Andreoni, R., 796
Andrews, W. O., 1472
Angel, C. M., 808
Antill, J. M., 1142
Applebaum, S. B., 384, 1621, 1621
Arbatsky, J. W., 1837
Ardrey, W. B., 1451
Arnold, F. A., Jr., 1298, 1299
Arnum, W. I. V., 1296

Babbitt, H. E., 1465
Bach, J. M., 1004, 1006
Baese, E., 2068
Bahlman, C., 387
Baier, C. R., 184
Bailey, G. B., 979
Bailey, W. T., 1296
Baker, M., 188
Baker, M. N., 1833
Bakke, O. M., 1840
Bartlett, T., 1147
Barton, C. J., 1848
Batta, G., 194
Baty, J. B., 380, 802
Bauer, W. W., 176
Baumann, P., 821
Baylis, J. R., 196, 1835
Beaumont, A. G., 1613
Bedert, W., 1459
Behrman, A. S., 367
Benninger, H. H., 1460
Benson, H. K., 1003
Berk, A. A., 372
Berman, M., 1469
Bernard, M., 1288
Berry, A. E., 195, 805, 1138, 1617, 1833
Berry, G., 172, 779, 786
Betz, L. D., 1470, 1471
Beuthe, H., 373
Bielenberg, R. G., 368
Biemond, C., 1131
Bigwood, B. L., 1290
Billinger, R. D., 1135
Binnie, W. J. E., 822, 1449
Binns, G., 1129
Blackmore, W. E., 985
Blume, A. L., 1153
Bond, D. H., 813
Booth, H., 1157
Boothman, A., 172, 779, 786
Borner, H., 1843
Boucher, P. L., 1832
Boucher, R., 825
Boudreaux, G., 1003
Bowdoin, C. D., 177
Bower, C. A., 1004
Bowman, J., 1449
Bowman, R. A., 1473
Bray, R. H., 1002
Breed, R. S., 1851
Brewer, J. H., 999
Brierley, J., 2072
Briggs, R. R., 1472
Briggs, W. E., 1473
Brines, M. E., 369
Britton, J., 1836
Britton, J. A., 803
Brod, H. W., 1288
Brooks, J. H., 813
Brown, C., 188
Brown, D. L., 1473
Browne, F. G., 979
Brownstead, J. P., 378
Bruce, H. H., 1469
Bruce, H. T., 1136
Bruins, P. F., 1469
Bruk, E. S., 1297
Bruns, H., 2075
Buchanan, R. E., 186
Buehrer, T. F., 1002
Bunn, C. W., 1471
Burnham, L. M., 1157
Burns, W. E., 1850
Burwell, J. H., 805
Bustamante, M. E., 1305
Buswell, A. M., 192, 382, 385
Butterfield, C. T., 185
Buydens, R., 1455, 1623

Cain, G. A., 371
Caldwell, D. H., 1465
Calvert, J. T., 1449
Camp, T. R., 1837
Campbell, M. S., 1454
Carnahan, C. T., 991, 1616
Carollo, J. A., 1136
Carpenter, L. V., 176, 366

CARR, E., 2070
CARRIEU, 178
CARTER, G. N., 825
CAUGHEY, R. J., 980
CECIL, T. A., 1615
CHALMERS, H. N. M., 1304
CHANDLER, D. C., 1297
CHARLEWOOD, C. B., 366
CHATELAIN, J. B., 371, 1147, 1623
CHATLEY, H., 976
CHUIKO, V. T., 1007
CHWALA, A., 1838
CLARK, J. D., 181
CLARK, L. M., 1471
CLARK, R. E. D., 995
CLARKE-HAFSTAD, K., 1287
CLEARY, E. J., 1131, 1134, 1281
CLERC, M., 812
COATES, J. J., 366
COCEA, E., 192
CODE, S. B., 985
COLBURN, A. P., 983
COLLINS, I. G., 190
COLLINS, J. H., 1614
CONKLING, H., 200
COOPER, A. M., 1149
COREY, H., 797, 1614
CORPUS, T., 178
CORYEA, C. E., 1473
COTTERELL, A. P. I., 1449
COUCHMAN, C. E., 990
COUGHLAN, R. E., 1473
COWLIN, F. J., 981
COX, C. D., 983
COX, C. R., 807
COX, G. L., 813, 1458
COX, G. N., 1292
CREAGER, W. P., 820
CRISP, A. E., 1617
CROSBY, I. B., 818
CYR, R., 195, 1139

DABAC, V., 2071
DALLAVALLE, J. M., 999
DANNENBAUM, J. B., 1147, 2076
DARBY, C. W., 190, 996
DARDANELLI, P. V., 811
DARLING, E. H., 1133
DAVIES, D. G., 816, 1616
DAVIS, A. R., 984, 1157
DAVIS, E., 1612
DAY, C. D. M., 1301
DEAN, H. T., 1298, 1299
DEBERARD, W. W., 374
DECKERT, W., 1849
DE GRAAF, J. A., 2061
DE HALLER, P., 815
DELAPORTE, A. V., 195
DE LA RIVIERE, R. D., 794
DENHOLM, E. W., 816
DESROCHES, E., 389
DICKMAN, S. R., 1002
DIENERT, F., 1284
DODSON, L., 802
DOHR, J. L., 1151
DOLAN, T. J., 1460
DONALD, M. B., 379
DONOSO, J., 178
DOSSETT, J. H., 1142
DOWNIE, C. C., 1287
DUHNSEN, W., 1834
DUNBAR, R. E., 989
DURHAM, G. E., 1472
DUSSERT, 373
DUTTON, M. S., 2070

EBNER, W., 983
EDMUNDS, F. H., 809
EDWARDS, W. R., JR., 1003
EGGLESTON, H. R., 1624
ELVOVE, E., 1298, 1299
ERIKSEN, A., 1283
EVANS, E. B., 1844
EVLANOVA, A. V., 1839
EWING, S., 1462
EYMER, H. H., 2066

FABIAN, F. W., 1851
FAIGENBAUM, H. M., 1283, 1284
FAUST, R. J., 386
FAWKES, A. W. E., 1139
FELLOWS, C. H., 370
FERRAMOLA, R., 190, 192, 995
FIELD, J. T., 193
FILBY, E. L., 384
FINK, C. G., 1448
FINLAY, G. R., 814, 1301
FINNIECOME, J. R., 976, 977, 979
FISCHER, H., 1848
FITZGERALD, P. E., 369
FLEBUS, C. G., 795, 1616
FLOYD, O. N., 823
FOLPERS, T., 1839
FOLPMERS, T., 189
FOLTZ, A. V., 1836
FORBES, H., 199
FORD, R. L., 1004
FOX, M. C., 1154
FRANCE, R. L., 998
FRASER, O. B. J., 813
FREIBERG, G. W., 191
FRITSCH, V., 2072
FULLER, H. U., 986, 2065
FULLER, J. E., 998
FULLERTON, R. M., 801, 1148
FULTON, A. A., 987, 988
FURBACH, E., 373

GARNER, J. H., 1281
GEAR, H. C., 813

Gelstein, A., 192
Gibbons, M. M., 1296
Gillette, D. W., 799
Gillo, L., 1001
Gladding, R. D., 1468
Goerke, H., 367
Goetz, H. C., Jr., 1471
Golubeva, M. T., 380
Gonzalez, M., 181
Gooden, E. L., 994
Gordon, J., 372
Gorman, A. E., 388
Gotting, H., 984, 1271
Graf, W. W., 372
Grant, E. L., 1289
Gray, M. T., 388, 1139
Greeley, S. A., 1283
Green, G., 1852
Gregoire, A., 1455
Griffin, A. M., 193
Grime, E. M., 2078
Griswold, H. W., 2069
Groesbeck, E. C., 1461
Guillaume, A., 1455
Guillerd, A., 1284
Guseva, K. A., 1298
Gustafson, H., 367

Haase, L. W., 811, 1008
Hadley, H. M., 822
Hadley, R. F., 810
Haering, D. W., 812
Hall, G. A., 380, 1625
Hall, G. L., 1306
Hammacher, J., 1450
Hancock, A. P., 1148
Hanemann, H., 2069
Hanks, J. H., 188
Hannemann, O., 987
Harding, H. A., 1303
Harmon, B., 2075
Harrell, D., 812
Harrington, A. W., 1290
Harrington, C. C., 1839
Harris, R. B., 199
Harris, W. E., 1301
Hartung, H. O., 196
Hartwell, O. W., 1290
Harvey, L., 805
Haseldine, J. F., 1276
Hatch, G. B., 376, 808, 1456
Haupt, H., 183
Haydock, C., 171
Hays, J. B., 823
Hegarty, C. P., 193
Herter, M., 1847
Herzik, G. R., 1850
Hettche, H. O., 2074
Hewitt, C. H., 1847
Hicks, W. F., 1296
Hills, B. M., 1625
Hippe, L., 179
Hirsch, A. A., 988
Hodges, P. V., 1288
Hoefle, K. F., 1157
Hofmann, W., 2069
Holaday, K. M., 812
Holler, H., 1141
Holton, P. J., Jr., 1456, 1624
Hommon, C. C., 380
Hook, A. E., 1851
Hoover, C. P., 1621, 1622, 1836, 1842
Hoover, E. F., 1136
Horner, J. L., 1147
Horner, W. W., 1289
Hoskins, J. K., 187, 1278
Hough, B. K., Jr., 824
Houk, I. E., 817
Houston, C. W., 1000
Houston, E. C., 989
Howard, N. J., 997, 1615, 1620, 1832, 1834, 1849
Howe, D. E., 1006
Howson, L. R., 801
Hughes, E., 186
Humphreys, W., 1284
Hunter, A. C., 191
Hupp, E. R., 189

Inglee, C., 2066
Irwin, C. H., 1841
Ivlev, V. S., 1298

Jack, L. B., 1149
Jackson, J. A., 1155
Jacobs, J., 817
James, D. F., 188
James, K. A., 1469
Jansen, L., 372
Jarvis, C. S., 1288
Jay, P., 1298
Jenkins, S. H., 1847
Jennison, M. W., 188
Jens, S. W., 1289
Johns, G. A., 1472
Johnson, G. D., 1469
Johnson, M. L., 1845
Johnson, W. S., 196
Joos, C. E., 1456
Juday, C., 1006

Kalinske, A. A., 1464
Kasper, K., 789
Kassner, E. E., 1003
Kassner, J. L., 1003
Katz, W., 1846
Kearney, S., 2065
Keeling, H. J., 812, 815
Keener, K. B., 817
Keller, G., 2074

KEMP, M., 1453
KENDALL, T. R., 385
KENDALL, V. V., 1456
KENNISON, H. F., 1289
KENWORTHY, L., 811
KEY, T. D., 377, 378
KHAL'FIN, F. H., 994
KILLIAN, P., 807
KINNISON, H. B., 1290
KIRCHRATH, H., 1147
KISSKALT, K., 2074
KLARE, M., 797
KLAS, H., 1461
KLINGMAN, F. W., 1842
KLOUMAN, F., 987
KLUMPP, J. B., 1843
KNAPP, G. S., 1287
KNAUSS, W., 797
KNILL, W. C., 784
KNORR, M., 2074
KNUDSON, H. W., 1006
KOBE, K. A., 1002
KOHN, F., 197
KOOIJAMS, L. H. L., 1839
KOPJEV, S. F., 1461
KUHN, R. J., 813
KUL'BERG, L. M., 1006
KUNI, V. E., 1454
KURODA, K., 1005

LACKEY, J. B., 194
LADUE, W. R., 2071
LAMMERS, F. J., 1845
LANDEL, E., 787
LANG, A., 2075
LANGER, A., 1004
LANZ, R. L., 379
LAPIN, L. N., 1849
LAQUE, F. L., 1458
LARSON, T. E., 382, 383, 385
LAUGHLIN, H., 1841
LAUTER, C. J., 382
LEIBOV, Z. M., 1005
LEIFSON, E., 1851
LEIPPER, A., 1002
LEMBCKE, P. A., 1303
LEMBERG, K., 1140
LEOPOLDI, G., 1848
LEVINE, M., 1453, 1852
LEWIS, A. C., 982
LEWIS, M. R., 199
LEWIS, W. Y., 365
LIEURANCE, R. S., 817
LILLIE, R. D., 1301
LINDQUIST, E. G. W., 390
LINDSAY, F. K., 368
LINFORD, A., 1463
LISBONNE, 178
LIVINGSTON, P., 2076
LLOYD, D., 1292
LLOYD, J. M., 1625
LOCHHEAD, A. G., 997
LOGAN, J., 1840
LONGLEY, F. F., 799
LOPEZ, S. R., 1302
LORDLEY, H. E., 1843
LOWE-BROWN, W. L., 815, 817
LUBIMOVA, A. A., 809
LUDLAM, M., 999
LULL, G. F., 175
LYMER, B. J., 977
LYNCH, H. B., 1290

MACDONALD, F. W., 802
MACGREGOR, M., 1141
MACKENZIE, E. F. W., 793, 1448, 1450
MACPHAIL, J. B., 825
MADDEN, J. T., 1153
MAGUIRE, J. J., 1470, 1471
MAHADEVA, S., 1158
MALBIN, B., 1302
MALLMANN, W. L., 190, 996, 1451, 1851
MANLEY, C. H., 1005
MANN, E. H., 181
MANNING, F. G., 1850
MANNING, W. M., 995
MANUILOVA, G. A., 1000
MARKWITH, R. H., 175
MARSH, J. A., 1842
MARSHALL, T. C., 812, 813
MARTIN, P. J., JR., 1136
MARTINA, A., 1838
MASCHERONI, H. A., 1299
MASON, M. A., 1466
MASSEY, A., 1128
MASTERSON, W. D., 1148
MATEI, I., 192
MATHESON, D. H., 390
MATTHEWS, F. J., 812, 1621
MATUBARA, T., 1459
MAZZOTTI, L., 181
MCBRIAN, R., 1470
MCCLURE, F. J., 179, 1300
MCCRADY, M. H., 997
MCDIARMID, F. J., 1155
MCDONNELL, R. E., 2065
MCDOWELL, E. T., 808
MCLACHLAN, J. A., 197
MEDAUGH, F. W., 1469
MEIER, F. E., 1297
MEINZER, O. E., 199
MELLON, M. G., 1006
MELOCHE, V. W., 1006
MENSCH, L. J., 821
MEN'SHCHIKOV, I. V., 1847
MERWE, P. K. V. D., 1299, 1300
MEYER, A. F., 1294
MICHELSON, I. D., 997
MILLER, L. B., 379, 1145
MILLIGAN, W. O., 1845, 1845

Mills, W. S., 1837
Mitchelson, A. T., 200
Mix, A. E., 1004
Moneymaker, B. C., 822
Monteverde, J. J., 190
Moon, A. M., 2066
Moon, C. D. B., 1006
Moore, W. A., 1000
Moroz, V. P., 1849
Morral, F. R., 815
Morris, R. M., 1294
Morrison, R. B., 988
Mortimer, C. H., 1846
Mosier, J. A., 1840
Mozzhukhin, P. V., 374, 1833
Muegge, O. J., 2076
Mueller, A. C., 1473
Mukharevskaya, M. I., 1298
Munoz, J. M., 1299
Murphy, E. J., 814
Murphy, J. J., 804
Muselmann, R., 2074

Nagle, W. M., 1473
Needlands, A. R., 816
Nelidov, I., 823
Neogi, S., 997
Neveu, R., 1451
Newton, F. A., 1156
Nichols, M. S., 180
Nicolas, Y., 1455
Noll, C. A., 1470, 1471
Norcom, G. D., 1622

O'Brien, R. A., 372
O'Connor, P. J., 1838
Ostrolenk, M., 191
Othmer, D. F., 1469
Owens, F. R., 370
Oyama, T., 1847

P., V., 799, 986
Palmer, C. E., 1836
Pandit, C. G., 181
Pankey, T. L., 1145
Parker, L. T., 803, 806
Parr, L. W., 998
Partridge, E. P., 1456
Paton, W. A., 1152
Paul, C. H., 817
Paul, J. R., 1303, 1304
Paulsen, C. G., 1290
Pearl, I. A., 1003
Pearsall, W. H., 1846
Peden, D., 996
Pehrs, M., 1305
Perkins, W. A., 821
Peters, W. F., Jr., 367
Petrie, L. M., 177
Pilling, N. B., 1457
Pincussen, L., 1847
Placak, O. R., 1000
Platonova, M. N., 1454
Poe, C. F., 193
Poland, J. F., 988
Poole, B. A., 1280
Pottinger, R. E., 1847
Powell, S. T., 366, 371
Powell, W. J., 1134
Prathithavanija, B., 1849
Pratt, F. R., 986
Prevot, A. R., 195
Pruss, M., 1285
Puncochar, J. F., 192
Purcell, W. R., 1845, 1845

Rafle, P. J., 1303
Rambault, 178
Rathe, W., 2074
Raven, C., 996
Rawn, A. M., 1284
Reedy, R. J., 192
Reid, G. U., 977
Reilly, T. L., 1294
Reinach, N., 184
Reindollar, W. F., 1009
Reinfel'd, E. A., 1457
Reitemeier, R. F., 1002
Reny, F. J., 1137, 2069
Ressmann, 815
Reussi, C., 1299
Reynolds, D. H. B., 783
Rhodes, A. J., 999
Rial, W. P., 1144
Rice, C. W., 1472
Rice, O., 808, 1622, 1852
Rich, G. R., 820
Richter, A., 386
Riegel, R. M., 821
Riney, A. H., 1468
Roberts, G. E., 1142
Roberts, J., 182
Robertson, J. E., 1134
Robertson, J. M., 1464
Robertson, S. A., 365
Robertson, W. A., 1133
Robinson, D. W., 1145
Roe, A. F., 1852
Rogers, W. F., 1462, 1463
Romanoff, A., 184
Ronald, D., 794
Routledge, C. G., 2065
Rovinskaya, E. I., 1006
Rozsa, P., 1277
Ruchhoft, C. C., 1000, 1000
Rudy, H., 1848
Rugg, C. F., 1289
Rupp, D. H., 376
Ryan, W. F., 1473

St. Hill, F. A., 1453
St. Laurent, G. C., 1132
Sandera, K., 1002
Sandwisch, R. H., 1621
San Juan, J. T., 178
Sapirie, S. W., 375
Sarchet, B. R., 983
Sauer, W., 197
Scales, F. M., 1453
Schaphorst, W. F., 977
Schaut, G. G., 182
Schemel, R., 1157
Schikorr, G., 812
Schimpff, G. W., 1847
Schloesser, H., 1848
Schneider, J. H., 2064
Schoenleber, A. W., 182
Schroeder, W. C., 372
Schuleen, E. P., 825
Schulek, E., 1277
Schulz, E., 1472
Schwabe, L., 1146
Schwartz, M. C., 1003
Schwarzler, C., 807
Schweigl, K., 2072
Schworm, W. B., 191
Sciver, A., 1450
Scott, L. H., 381, 2064
Scott, W. M., 1469
Selivanov, L. S., 1005
Setter, L. R., 176
Shaw, P. A., 1158, 1279
Shee, J. C., 1304
Shelton, L. R., Jr., 998
Shinn, M. B., 1008
Shipley, J. W., 814
Shnidman, L., 814
Shuchkova, A. M., 1844
Shuey, B. S., 1844
Shustova, L. N., 374, 1833
Silcox, H. E., 813
Sillitto, A. G., 1008
Simonds, A. W., 822
Skopintsev, B. A., 380, 1297
Small, A., 805
Small, L., 2067
Smith, C. M., 994
Smith, E. E., 380
Smith, F. E., 191
Smith, M. I., 1301
Smith, N. L., 1154
Smith, O. M., 1004
Smith, R. S., 194
Smith, W. T., 812
Snow, B. F., 199, 374
Snow, F. H., 1295
Solov'ev, A. V., 809, 809
Sorensen, C., 373
Spacek, L. P., 1152
Spencer, W. R., 802
Spitta, O., 176, 187
Splittgerber, A., 368
Spurway, C. H., 383
Stager, H., 1459
Stapley, E. R., 802, 1836
Steele, B. W., 819
Steyn, D. G., 184
Stipp, A. C., 198, 2077
Stohlman, E. F., 1301
Stone, C. M., 188
Straub, J., 181
Streatfield, E. L., 1846
Strickland, G. H., 389, 1617
Stuart, A. H., 1457
Stuart, C. A., 188, 193
Stundl, K., 1835
Suedkamp, J. E., 382
Sugawara, K., 1847
Suter, M., 192
Sutherland, R. A., 820
Suvorova, R. V., 1839

Tanner, F. W., 1000
Taylor, D. R., 983
Taylor, F. S., 1625, 1842
Teis, K. R., 1146
Thackwell, H. L., 1838
Thayer, H., 2077
Theis, C. V., 197
Thiele, H., 1305
Thiem, G., 2073
Thomas, H. A., 825
Thompson, D. G., 172
Thompson, L. N., 383
Thompson, R. E., 1624
Thorn, F. C., 978
Thorp, C. E., 1007
Thuma, R. A., 1298
Tiemersma-Wichers, G. M., 809
Tisdale, E. S., 1280
Tolman, C. F., 198, 2077
Tomlinson, G. H., 1285
Townsend, L. D., 1283
Trask, J. D., 1303, 1304
Traxler, H., 806
Tray, S. E., 1145
Treadwell, E. F., 199
Trelles, R. A., 1004, 1006
Truog, E., 1004
Tuepker, D. J., 1151
Tully, J. P., 1009
Tupholme, C. H. S., 371, 1459
Turnbull, W. J., 825
Turner, H. G., 1836
Turner, W. D., 367
Tuthill, L. H., 822
Tyagaraja, S., 999
Tyler, I. L., 819
Tyo, Z., 1834

ULMER, R. C., 1473
UNWIN, R., 1150

VAKSBERG, N. M., 1847
VAN NIEVELT, B. F., 1144
VANSELOW, A. P., 1001
VERONELLI, D. J. E., 811, 1459
VESSELOWSKY, S., 980
VINOGRADOV, A. P., 1297
VOLKOV, P. I., 370
VON GONTARD, A., 812
VON POST, E., 381
VOZNESENSKII, S. A., 1839

WADSWORTH, G. P., 188
WALKER, C. L., 802
WALKER, J. H., 1456
WALKER, O. J., 1300, 1301, 1622
WALSH, E. L., 803
WALSHE, R. L., 1141
WALTERS, R. C. S., 1449
WALTON, R., 377, 378
WARREN, A. C., 1134
WATANABE, I., 369
WATANABE, M., 1458
WATSON, D. M., 1449
WATSON, R. G., 1841
WATZEL, R., 1848
WEBER, B., 2074
WEBER, G. R., 1453
WEEKS, O. B., 193
WEISER, H. B., 1845, 1845
WELDE, V. J., 376
WELLINGTON, S. H., 1453
WENZEL, L. K., 200, 2073
WERKMAN, C. H., 189
WESLEY, W., 368
WESLEY, W. A., 1457, 1457
WEST, J. A., 1125
WESTFALL, B. B., 1301
WHITE, E. G., 1454
WHITNEY, R. J., 1845
WHITSON, M. T. B., 376
WIEGMANN, H., 1286
WIEL, S. C., 198
WIESBROCK, H., 183
WILCOXSON, L. S., 1285
WILDON, C. E., 383
WILHELM, R. H., 990
WILLIAMS, A. E., 375
WILLIAMS, G. R., 1291
WILLIAMS, J. A., 1148
WILLIAMS, N., 1462
WILM, H. G., 1465
WILMOTH, V. J., 786
WILSON, E. K., 2064
WILSON, H. M., 1295
WILSON, J. H., 1461
WILSON, R. J., 182
WINKLER, A., 183
WOLFE, E. E., 1455
WOLPERT, N. N., 1137
WOOD, H. G., 189
WOOD, J. N., 784, 816
WOODRING, R. W., 1135
WOOLLEY, R. R., 2077
WORDLEY, E., 186
WRIGHT, H. D., 996
WRIGHT, W. A. S., 813

YEAW, J. S., 814
YODER, J. D., 1470
YOE, J. H., 1848
YOUNG, J. E., 387
YOUNG, J. W., 1295

ZAY'YALOV, I. N., 2076
ZHUKOV, A. I., 1835
ZIEGLER, N. R., 998
ZIMMERMAN, A., 188
ZOBELL, C. E., 195
ZVENIGORODSKAYA, A. Y., 1000

A.W.W.A.

PUBLICATIONS

Books

MANUAL OF WATER QUALITY AND TREATMENT.—A 300-page *Manual* of information brought up to date from material originally published in 1925 as a part of the Manual of Water Works Practice. The rewriting was directed by Paul Hansen and the late Lewis V. Carpenter. Eleven chapters cover: Characteristics of Available Sources; Organisms in Water; Standards of Quality; Purification Occurring in Streams, Lakes and Reservoirs; Partial Treatment and Treatment Preliminary to Filtration; Coagulants and Coagulation; Chlorine and Other Chemicals; Tastes and Odors; Filtration; Chemical Conditioning of Waters; and Treatment Plant Control. The book is complete with over 50 illustrations, graphs and charts and has a complete index and bibliography. Published in 1940; reprinted in 1941. Price to A. W. W. A. Members, $2.50; to A. W. W. A. Members who send cash with order, $2.25; to non-members, $3.00.

INDEX TO THE PROCEEDINGS, JOURNAL AND OTHER PUBLICATIONS.—This Index covers 59 years of A. W. W. A. publications: the Proceedings for 1881 through 1913; the Journal for 1914 through 1939; and other Association publications. In the 285 pp. of the book are given: a chronological listing of all published papers (grouped under 70 major subjects of the water works field); a complete author index; and a list of other publications of the A. W. W. A. or published in co-operation with other organizations. Price to A. W. W. A. Members, $1.75; to A. W. W. A. Members who send cash with order, $1.50; to non-members, $2.00.

MANUAL OF WATER WORKS ACCOUNTING.—Prepared jointly by the A. W. W. A. and the Municipal Finance Officers Association, this 500-page Manual contains twenty chapters covering: Accounting Organization and Control; Accounts; Books of General Entry and Accounting Documents; Customer Accounting Procedure up to Time of Billing; Customer Billing and Bookkeeping; Purchases; Accounting for Materials and Supplies; Payroll Accounting; Accounting for Contractual Services, Interest on Notes, and Taxes; Depreciation; Distribution of Clearing Accounts; Cost Accounting; Accounting for Cash; Restricted Funds; Investments; Plant Accounting; Creditor and Ownership Equities; Preparation of Financial Statements; and Financial Policies and Planning. Published in 1938. Price, for general sales, $4.00; to A. W. W. A. Members who send cash with order, $3.20.

STANDARD METHODS FOR THE EXAMINATION OF WATER AND SEWAGE.—Published jointly by the A. W. W. A. and the American Public Health Association with collaboration of the American Chemical Society. Eighth Edition, 1936. Cloth bound, 300 pages. Available through the American Public Health Association, 1790 Broadway, New York, N. Y., at $2.50 per copy.

WATER-BORNE OUTBREAKS IN THE UNITED STATES AND CANADA AND THEIR SIGNIFICANCE.—By Arthur E. Gorman and Abel Wolman. Published in the February 1939 JOURNAL, p. 225. This 150-page book is a unique compilation and a valuable interpretation. Published separately from the JOURNAL at $1.00 per copy.

Specifications for Cast-Iron Pipe, Fittings, Lining and Laying

AMERICAN RECOMMENDED PRACTICE MANUAL FOR THE COMPUTATION OF STRENGTH AND THICKNESS OF CAST-IRON PIPE—A.S.A. A21.1-1939.—Adopted by the A. W. W. A. December 1939 and published as a part of the December 1939 JOURNAL. 81 pp. Reprints, 40¢ per copy.

AMERICAN STANDARD SPECIFICATIONS FOR CAST-IRON PIT CAST PIPE FOR WATER OR OTHER LIQUIDS—A.S.A. A21.2-1939.—Adopted by the A. W. W. A. December 1939 and published as a part of the December 1939 JOURNAL. 23 pp. Reprints, 20¢ per copy.

AMERICAN STANDARD SPECIFICATIONS FOR CEMENT MORTAR LINING FOR CAST-IRON PIPE AND FITTINGS—A.S.A. A21.4-1939.—Adopted by the A. W. W. A. December 1939 and published as a part of the December 1939 JOURNAL. 9 pp. Reprints, 15¢ per copy.

STANDARD SPECIFICATIONS FOR CAST-IRON SPECIAL CASTINGS.—The portion of the A. W. W. A. 1908 Specifications for Cast-Iron Water Pipe and Special Castings which relates to special castings has not yet been superseded by new material produced by the American Standards Association Committee A21. Until such time as this Committee completes its report A21.7, the A. W. W. A. 1908 Specifications continue to be a basis for purchase *insofar as they relate to special castings only*. 36 pp. Reprints, 30¢ per copy.

STANDARD SPECIFICATIONS FOR LAYING CAST-IRON PIPE—7D.1-1938.—Adopted by the A. W. W. A. April 28, 1938 and published in the February 1938 JOURNAL. 28 pp. Reprints in two sizes (8½ in. by 11 in. for binding with contract documents, and 6 in. by 9 in. for reference), 15¢ per copy.

Specifications for Steel Pipe and Coatings

STANDARD SPECIFICATIONS FOR RIVETED STEEL PIPE—7A.1-1940.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. April 25, 1940. 11 pp. Reprints, 15¢ per copy.

TENTATIVE SPECIFICATIONS FOR LOCK-BAR PIPE—7A.2-T.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and approved only as Tentative Specifications by the A. W. W. A. April 25, 1940. 12 pp. Reprints, 15¢ per copy.

STANDARD SPECIFICATIONS FOR ELECTRIC FUSION WELDED STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—7A.3–1940.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. April 25, 1940. 26 pp. Reprinted under same cover as 7A.4–1941, description of which follows.

STANDARD SPECIFICATIONS FOR STEEL WATER PIPE OF SIZES OF 4 INCHES UP TO BUT NOT INCLUDING 30 INCHES—7A.4–1941.—Published as Tentative Specifications as a part of the June 1940 JOURNAL and adopted as Standard by the A. W. W. A. June 26, 1941. 28 pp. Reprinted under one cover with 7A.3–1940, 25¢ per copy.

STANDARD SPECIFICATIONS FOR COAL-TAR ENAMEL PROTECTIVE COATINGS FOR STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—7A.5–1940.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. April 25, 1940. 38 pp. Reprinted under same cover as 7A.6–1940, description of which follows.

STANDARD SPECIFICATIONS FOR COAL-TAR ENAMEL PROTECTIVE COATINGS FOR STEEL WATER PIPE OF SIZES OF 4½ INCHES OUTSIDE DIAMETER UP TO BUT NOT INCLUDING 30 INCHES—7A.6–1940.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. April 25, 1940. 32 pp. Reprinted under one cover with 7A.5–1940, 30¢ per copy.

STANDARD SPECIFICATIONS FOR CEMENT-MORTAR PROTECTIVE COATING FOR STEEL WATER PIPE OF SIZES 30 INCHES AND OVER—7A.7–1941.—Published as Tentative Specifications as a part of the January 1940 JOURNAL and adopted as Standard by the A. W. W. A. June 26, 1941. 22 pp. Reprints, 20¢ per copy.

Specifications for Valves, Sluice Gates and Fire Hydrants

STANDARD SPECIFICATIONS FOR GATE VALVES FOR ORDINARY WATER WORKS SERVICE—7F.1–1938.—Adopted by the A. W. W. A. April 28, 1938 and published in the March 1939 JOURNAL. 15 pp. Reprints, 15¢ per copy.

TENTATIVE SPECIFICATIONS FOR SLUICE GATES—7F.2–T.—Approved as Tentative Specifications by the A. W. W. A. June 26, 1941 and published as a part of the October 1941 JOURNAL. 11 pp. Reprints, 15¢ per copy.

STANDARD SPECIFICATIONS FOR FIRE HYDRANTS FOR ORDINARY WATER WORKS SERVICE—7F.3—1940.—Adopted as Standard Specifications by the A. W. W. A. January 17, 1940 and published as a part of the August 1940 JOURNAL. 12 pp. Reprints, 15¢ per copy.

UNIFORM MARKING OF FIRE HYDRANTS: STANDARD COLORS FOR PAINTING TO INDICATE FLOW CAPACITY—7F.3.1–1937.—Published in the April 1937 JOURNAL and adopted by the A. W. W. A. June 7, 1937. 2 pp. Reprints, 5¢ per copy.

Other Specifications

STANDARD SPECIFICATIONS FOR ELEVATED STEEL WATER TANKS, STANDPIPES AND RESERVOIRS—7H.1–1941.—Published as Tentative Specifications as a part of the December 1940 JOURNAL and adopted as Standard by the A. W. W. A. June 26, 1941 and by the American Welding Society July 23, 1941. 51 pp. Reprints in two sizes (8½ in. by 11 in. for binding with contract documents, and 6 in. by 9 in. for reference), 30¢ per copy.

TENTATIVE SPECIFICATIONS FOR COLD WATER METERS—DISPLACEMENT TYPE—7M.1–T.—Approved as Tentative Specifications by the A. W. W. A. November 1941 and published as Tentative Specifications in the December 1941 JOURNAL. 14 pp. Reprints, 20¢ per copy.

Committee Reports and Recommended Practices

REPORT ON CHEMICAL HAZARDS IN WATER WORKS PLANTS—CHLORINE—5B.1–1935.—Published in the September 1935 JOURNAL. 24 pp. Reprints, 20¢ per copy.

REPORT ON CHEMICAL HAZARDS IN WATER WORKS PLANTS—AMMONIA—5B.2–1936.—Published in the November 1936 JOURNAL. 14 pp. Reprints, 20¢ per copy.

REPORT ON CHEMICAL HAZARDS IN WATER WORKS PLANTS—SULFUR DIOXIDE AND CAUSTIC SODA—5B.3–1939.—Published in the March 1939 JOURNAL. 13 pp. Reprints, 20¢ per copy.

REPORT ON SPECIFICATIONS AND TESTS FOR WATER PURIFICATION CHEMICALS—POWDERED ACTIVATED CARBON.—Published in the July 1938 JOURNAL. 92 pp. Reprints, 35¢ per copy.

RECOMMENDED PRACTICE FOR DISTRIBUTION SYSTEM RECORDS—7G.1–1940.—Published in the February 1940 JOURNAL. 61 pp. Reprints, including two related papers covering "Office Forms" and "Co-ordinating Operating System Records With Accounting Records, 25¢ per copy.

News of the Field

Another Convention Has Come and Gone

Members of the Association, who were fortunate enough to have been in Toronto in 1929, remembered what a pleasant time they had on the occasion of the last visit and knew that the conveniences for Convention attendance were quite adequate. Those who had never been in the Dominion and in Toronto before found themselves pleasantly at home after a very few minutes in the City.

Fourteen hundred and forty-five registered at the A. W. W. A. desk, and participated in the technical sessions, exhibits and entertainment. Quite a few others came to Toronto on account of the Convention but did not record themselves. In other words, it is rather clear that the Kansas City registration figure of fourteen hundred and sixty-seven (which still remains top for A. W. W. A. attendance) could have been exceeded if pressure had been put upon these reluctant individuals, but there is such a thing as pushing this "bigger and better" idea too far.

Anyone who knows Conventions and who happens to remember what is going on in the world today, will realize that a registered attendance of fourteen hundred and forty-five at Toronto in 1941 represents a degree of interest in Association affairs equivalent to no less than seventeen hundred and fifty registrants in normal times.

For the first time, it has appeared to be important to develop an accurate breakdown of the method people use to travel to the Convention City. Out of the fourteen hundred and forty-five who registered, thirteen hundred and ninety-three furnished the information needed. It is quite interesting!

In the order of number, automobiles led with eight hundred and seventeen. Trains brought five hundred and twenty-two people. Forty-nine came in by plane. Five used the bus. Five, believe it or not, came by boat. This indicates that Convention planning needs to take into account the highway situation adjacent to a Convention City, and especially the garage facilities available near the hotel.

(Continued on page 2)

(*Continued from page 1*)

At the close of the Hill Cup competition, as of Wednesday noon, June 25, the Association membership total was forty-one hundred and forty members. This continues the record-breaking growth.

The California Group, which now totals five hundred and thirty-six, continues to lead in Section Membership. The nearest competitor is the New York Section with four hundred and fifty-two. This means that the Old Oaken Bucket stays on the sunny shores of California.

The Pacific Northwest Section went to town in winning cups. It not only won the Hill Cup for the greatest percentage gain in Members since the Kansas City Convention (24.26 per cent), but it won the Henshaw Cup by having the greatest percentage of its Members present (78 per cent of its one hundred and forty-one members) at the recent Seattle Meeting. These boys in the Northwest certainly give the rest of the Association plenty of competition.

The Diven Medal, presented annually to that member judged to have made the greatest contribution during the year to the advance of the water works field, was awarded to William W. Hurlbut of Los Angeles for his leadership of the committee which developed the Association's steel pipe specifications.

Paul Weir of Atlanta, Ga., was awarded the Goodell Prize for 1941 for his paper, "The Effect of Internal Pipe Lining on Water Quality," published in the September, 1940, JOURNAL.

Made Honorary Members of the Association were: J. Walter Ackerman, retired Chief Engineer of the water department of Utica, N. Y.; R. C. Harris, Commissioner of Works at Toronto; and Frank C. Jordan, Secretary of the Indianapolis Water Company.

Recipients of Fuller Memorial Awards, listed by Sections, are as follows: California, William W. Hurlbut; Canadian, Walter Moffat Scott; Florida, Ralph W. Reynolds; Four States, I. M. Glace; Illinois, Frank C. Amsbary, Jr.; Indiana, Paul C. Laux; Kentucky-Tennessee, J. P. Brownstead; Michigan, Walter LeRoy Mallman; Minnesota, Felix Seligman; Missouri Valley, D. L. Erickson; Montana, W. M. Cobleigh; New Jersey, George R. Spalding; New York, R. Gordon Yaxley; Ohio, M. F. Hoffman; Pacific Northwest, W. P. Hughes; Southeastern, James E. Gibson; Southwest, V. M. Ehlers; Western Pennsylvania, Chester F. Drake; West Virginia, John B. Harrington; and Wisconsin, A. P. Kuranz.

Technically, the Convention was quite a success. The papers were of a very high level. Discussions on Civil Service, Public Relations, Water Quality, and Distribution System Safety commanded a great deal of attention.

The Exhibit was fine—it was convenient and it was a clean and bright looking assembly of water works equipment.

(*Continued on page 4*)

WHERE TUBERCULATING WATERS MUST BE TRANSPORTED

(LESS THAN 25% OF THE U. S. A.)

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THE areas of the United States where tuberculating waters materially affect the carrying capacity of pipe represent *less than one-quarter of the total area of the country.* If you are located within one of these areas, use *lined* cast iron pipe. You do *not* have to sacrifice the long life, low maintenance cost and salvage value of cast iron pipe in order to be assured of high carrying capacity throughout the life of the pipe you buy. The Cast Iron Pipe Research Association recommends *lined* cast iron pipe where tuberculating waters must be transported. Lined cast iron pipe is the only pipe that will have 100 years of useful life plus 100 years of high carrying capacity. Send for map which shows approximately 76% of the country where little or no tuberculation is to be expected. Lined cast iron pipe is made in sizes from 1¼ to 84 inches.

**Various types of linings are available to meet various conditions and preferences of users.*

CAST Q IRON

Look for the "Q-Check" Registered trade mark.

The Cast Iron Pipe Research Ass'n, T. F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago, Ill.

CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

The entertainment furnished during the evening hours represented Toronto's finest talent.

The Royal York Hotel management is an unparalleled group in courtesy and conformance to obligation.

The Board of Directors, among many matters, organized two very important committees. A Committee of more than twenty superintendents and managers has been set up to study the various forms of water department control existing in the United States and Canada.

The Board also authorized President Howson to appoint a Committee on Defense. The scope of its activities is defined along these lines:

(1) To obtain information concerning the effect of the Defense program upon water supply activities;

(2) To present to proper Governmental authorities the case as it affects water works, and obtain whatever consideration and rulings appear to be properly indicated; and finally

(3) To transmit to the water works field all information available, which is related to the Defense program in its effect on the water works field.

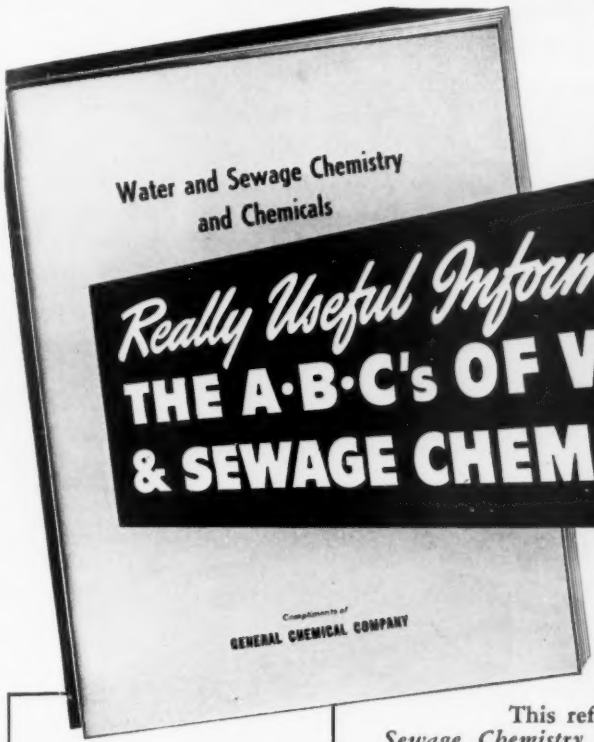
This means that any water works man who finds the operation of his property adversely affected by the priorities and materials situation, should direct a communication to the Association's office in New York. That communication should tell precisely what was needed; where it was ordered; and what reasons have been given for not accepting the order, or for delay in shipping. If the case follows a pattern already known to the Association's staff, immediate advice will be given, indicating the steps that have to be taken to obtain the materials. If it represents a new development, a check will be made in Washington to find out precisely what is the proper procedure to follow.

One very important communication came into the Association's hand during the Convention—a letter from Priorities Director Edward R. Stettinius to Dr. Thomas Parran, head of the United States Public Health Service, advising that *chlorine* for sanitation purposes would be given priorities rating equal to Defense materials. This is a most important ruling. The rumors about inability to obtain chlorine for water works purposes should now be definitely allayed. Further reference to this matter will be found elsewhere in this issue of the JOURNAL.

The Board of Directors and the Convention Place Committee gave extraordinarily careful consideration to the representations which had been made by the cities desiring the 1942 Convention of the Association. It was felt that the international conditions were unlikely to be materially improved and that conservatism in the selection of a Convention site was definitely desirable. The Board therefore voted to hold the 1942 Convention of the A. W. W. A. in Chicago.

Hail Chicago! Farewell and thank you Toronto!

(*Continued on page 6*)



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Information for Every Operator—
Compiled by
Water and Sewage Authorities

DEALS IN "PLAIN LANGUAGE" WITH THESE SUBJECTS:

- Chemical Terms and Symbols
- How Chemicals Combine
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This reference book, *Water and Sewage Chemistry and Chemicals,* should find a place in the library of every plant manager, chemist and engineer interested in water or sewage treatment. It is a reprint of material which appeared recently in Public Works Magazine. General Chemical Company is pleased to make the booklet available now to those who may not have had the opportunity to read it.

Photographs, drawings, tables; and clear, concise writing make *Water and Sewage Chemistry and Chemicals* a valuable booklet for layman and technician alike!

To get your copy, fill out coupon below and mail to General Chemical Company.

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(*Continued from page 4*)

The gavel from the Association's 1888 Convention now is preserved in an ingenious case designed by Clinton Inglee.

The gavel is labeled "American Water Works Association – J. T. Fanning, President, Cleveland, 1888." After its use by the sixth A. W. W. A. President, it came to rest in Minneapolis. Here were the headquarters of that famous hydraulic and water works engineer who wrote the noted treatise on hydraulics and prepared many basic formulas for hydraulic practice. Upon the death about a year ago of J. T. Fanning's son, who had carried on his father's work, the gavel came to the attention of J. Arthur Jensen,

J. T. Fanning's gavel and its unique case

Engineer, Minneapolis Water Works Dept. Mr. Jensen gave it to the Association at the Board of Directors Meeting last January.

The head of the gavel is made in the form of a tee pipe casting with bell ends which are closed with wooden plugs to make striking surfaces. The handle is attached by the side branch of the tee.

The main body of the case, made by Clinton Inglee, President of the National Water Main Cleaning Co., is a section of an old wooden water main. It was laid in Washington St., between Liberty and Cedar Sts., New York City, in 1800 by the Manhattan Company which had been incorporated in 1799 by Aaron Burr. The main was removed in 1910 and preserved by the National Water Main Cleaning Company. A section of

(*Continued on page 8*)

WATCH DOG
WATER METERS
. . . built to give
LASTING SATISFACTION
The Worthington-Gamon Meters of today represent an experience of 85 years . . . dating back to the invention of the piston meter, in 1855, by Henry R. Worthington.
With 3,650,000 meters now serving thousands of communities, this organization offers to municipalities and water companies a product whose accuracy and low maintenance requirements have proved it to be a sound investment.
Write for literature.
WORTHINGTON-GAMON METER COMPANY
General Offices: HARRISON, NEW JERSEY
WORTHINGTON-GAMON
WG1-2A

(*Continued from page 6*)

the main containing a knot was thus admirably suitable for encasing the gavel which is fitted like a key extending across the bore of the main and into the knot. The base and cover are finely worked and polished, the cover bearing the Association initials.

Joseph M. Sanchis returned to service with the Division of Sanitary Engineering, Los Angeles Dept. of Water and Power, in April. Mr. Sanchis left the position of Chief Chemist and Bacteriologist with the Los Angeles Dept. in March, 1938, to go to Venezuela as Chief of the Water Analysis Laboratory of the Ministry of Public Works. Mr. Sanchis's paper in the February, 1941, JOURNAL shows the success Venezuela is achieving in a progressive program to build up a large efficient laboratory organization with graduates of Venezuelan Universities.

Mr. Sanchis attended elementary and high school in Valencia, Spain. He majored in sanitary engineering while earning the degree of B.S. in Civil Engineering at the University of California, Berkeley, Calif., and he received the degree of M.S. (chemistry) from the University of Southern California at Los Angeles. Besides his five years' service with the Los Angeles Dept. before going to Venezuela on a leave of absence, Mr. Sanchis's service in the field included work as: Engineering Assistant with the Oakland, Calif., Division of Sanitation and Drainage; Civil Engineering Aid, California State Division of Highways; and Junior Sanitary Engineer for the Division of Sanitary Engineering, California State Dept. of Public Health, and the Division of Water Resources, California State Dept. of Public Works.

Mr. Sanchis has for several years been known to JOURNAL readers as a contributor to the Abstract Section.

"Aftermath of the Rochester Water Supply Pollution" is here quoted complete from the New York State Dept. of Health's *Health News* of April 28, 1941:

(*Continued on page 10*)

Filtration Room at This Plant Coated Throughout with TRIPLE-A.

Protect the Surface—Save the Structure

Where destructive conditions prevail, and service is severe . . . TRIPLE-A Protective Coatings adequately fill the requirements for Heavy-Duty Coatings that can withstand acids, alkalies, moisture, air and other corrosive influences.

Each TRIPLE-A coating has distinctive properties and applications. The Plant Superintendent of a large water works* makes the following statement regarding TRIPLE-A No. 20: "We have painted underground piping with water dripping off it with TRIPLE-A, and with surprising results. After two years the original coating presents the same coverage and glossy appearance that it did when it was applied."

No wonder TRIPLE-A Protective Coatings are so widely used throughout the Water Works Industry.

Write for Bulletin No. 375 for complete details.

*Name on request.

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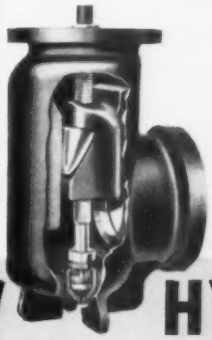
GREAT FALLS, MONT.

THEY ALL USE LUDLOW HYDRANTS

On Guard in these and other cities, Ludlow Hydrants insure complete security winter and summer, year in and year out. The famous slide gate principle, developed and perfected by Ludlow, provides *quick water* with least possible shock; proper shut-off without water hammer. Drainage at lowest point prevents freezing; wedge locking gate prevents flooding . . . Write for a free copy of Catalog No. 201.



LUDLOW DOUBLE GATE VALVES

One inch or 60 inches, the parallel seat, double disc-type slide gate valve, developed and perfected by Ludlow, has been the universally accepted construction in water works valves—of all sizes—for nearly three-quarters of a century.

LUDLOW HYDRANTS

THE LUDLOW VALVE MANUFACTURING CO., INC. • TROY, N. Y.

(*Continued from page 8*)

"Approximately *34,000* persons in Rochester and vicinity became ill, according to recent estimates, following ingestion of water from the Hemlock drinking supply system which became polluted when a valve on a cross-connection between the fire and the potable supply was opened by mistake December 11. (See *Health News*, December 23, 1940 and January 6, 1941.)

"Estimates based on a survey by Rochester Health Bureau nurses of about twenty representative households in each of fifty-three public and parochial school districts in the city of Rochester indicate that about 30,000 residents developed gastroenteritis, characterized by nausea and vomiting, diarrhea and abdominal cramps, in the period December 12–18. Surveys were conducted only in homes served by the Hemlock water supply system and covered 4115 persons in 796 families, or 1.38 per cent of the total population of the area studied.

"Approximately 3400 residents of Monroe county outside of Rochester apparently were similarly affected bringing the number of illnesses to more than 33,000. Assuming that 1000 or more cases occurred among transients and residents of neighboring counties, it seems likely that over 34,000 persons were made ill by pollution of the Hemlock water supply.

"*Six* definite cases of typhoid fever were recognized, the clinical diagnosis being confirmed by positive agglutinations and fecal cultures. In five the blood culture was also positive.

"Five cases occurred in males, ages eight, nine, twenty-six, thirty and

(*Continued on page 12*)

Stuart K. Knox, Consulting Engineer of Montclair, N. J., died at the age of 62 on June 28 in Montclair, where he had lived for the past 26 years.

A native of Michigan, he was graduated from the University of Michigan in 1903 with the degree of Civil Engineering. His extensive engineering experience began with employment as an inspector with the United States Army Engineers. He served as instrument man on irrigation and drainage surveys in Texas, then from 1904 to 1907 he was associated with the engineering firm of Thompson-Starrett, New York. In 1907 he became Superintendent of Construction for the Foundation Company of New York. From 1908 to 1934 he was a partner in the engineering firm of Nicholas S. Hill, Jr., New York. In 1934 he established his own firm.

During the World War, he served as Engineer in charge of design for Camp Merritt, N. J. He had also served as Engineer in charge of design and construction of housing developments for the U. S. Housing Bureau. Mr. Knox had been a member of the A. W. W. A. since 1909.

NOW. . .

K&M *"Century"* Pipe
available in 18-foot lengths,
sizes 6" and 8" class 150...
...28% fewer joints!

FOR the first time, light-weight asbestos-cement pipe is available in long 18-foot lengths. This is an exclusive development of Keasbey & Mattison Co., makers of "Century" Pipe, and it provides you with a pipe that cuts 113 joints out of every mile of line.

The new 18-foot lengths, available in both 6" and 8" sizes, class 150, are quickly and easily handled without winches or other mechanical equipment. The installation time you save speeds up pipe laying and cuts costs. Because of "Century" Pipe's light weight, no additional man-power is required to handle the 18-foot lengths.

Particularly on long stretches of line you will find this new development a means of saving substantially on the time and cost of a project.

"Century" Asbestos-Cement Pipe is well known for its maintenance-free service under extreme conditions. It never tuberculates or corrodes. Its interior stays lastingly smooth, keeping down pumping cost. Its "Century" Flexible Couplings provide tight joints and are easy to install. Write Dept. 1017 for free booklet, "Mains without Maintenance."

K&M best in asbestos

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

(*Continued from page 10*)

forty-nine years, and one developed in a female, age thirty years. None died and none became chronic carriers. Each of the patients resided or was regularly employed in an area of Rochester where bacteriological examination showed the water to be polluted and each gave a history of drinking Hemlock water without boiling on December 11 or 12. One gave a history of receiving a single dose of typhoid vaccine in 1935; none of the others received any vaccine. The dates of onset were December 26, 27, 29, January 1, 10 and February 22. This last case was a nine-year-old boy who was playmate and school classmate of the eight-year-old boy who had onset January 10. Since the latter was not diagnosed until February 15, there was opportunity for transmission by contact and in the absence of any other detectable source it was felt that the last case was secondary to that developed by his playmate."

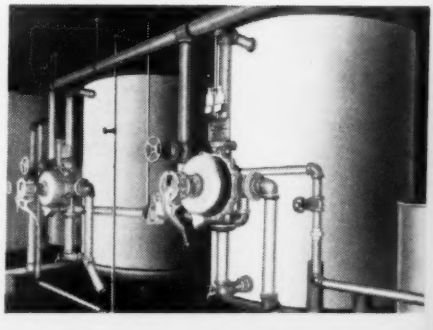
Parlon is a new base made available to paint manufacturers for their own formulations by Hercules Powder Company. It is a chlorinated rubber paint base designed to resist the corrosive action of atmospheres containing acids or alkalies and may prove especially valuable as protection in sewage plants where hydrogen sulfide is generated.

(*Continued on page 14*)

STOP DEPOSITS of Iron and Manganese

● The average municipal water system gets its toughest competition from iron and manganese. These twin bug-a-boos of profit cause deterioration of mains and meters, cause pressure losses and frequent hydrant flushing, clog meters and lines, discourage new customers, deter new industries from locating in your city, retard population growth.

Eliminate hardness, iron and manganese from your water in a single, simple operation—with REFINITE Water Conditioning equipment. Write for FREE brochure on "Municipal Water Conditioning."



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The Back River Sewage Treatment Station of the City of Baltimore requires large quantities of compressed air continuously to activate the sludge in the aeration tanks where organic matter is broken down by bacterial action.

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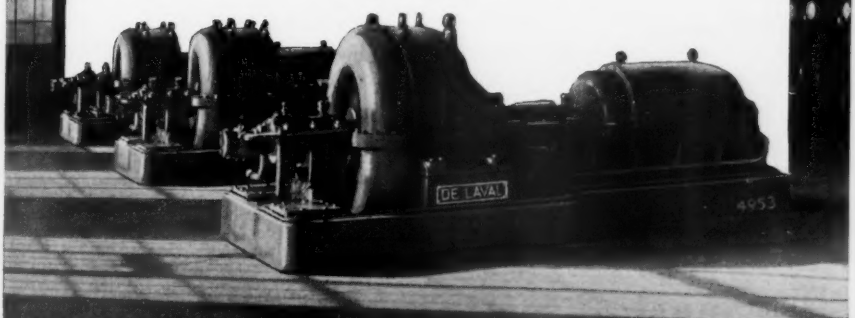
have been installed, each rated at 16,500 cu. ft. of air per min. against 7.5 lb. per sq. in. discharge pressure with 3 in. water column suction.

De Laval centrifugal blowers and compressors are built for all capacities, for all pressures up to 100 psi. and for motor or steam turbine drive.

Ask for Catalog F-3823



DE LAVAL STEAM TURBINE CO.
TRENTON, NEW JERSEY

(*Continued from page 12*)

Report of the Pacific Northwest Section Meeting

The Fourteenth Annual meeting of the Pacific Northwest Section was held in Seattle, Washington, at the Olympic Hotel on May 8, 9 and 10, 1941. Two hundred sixty-three members of the association and water works superintendents of the Pacific Northwest were in attendance at the largest convention ever held in this section.

President Norman J. Howard arrived from Toronto, Canada, on Thursday morning by plane and was met by Chairman Robert Duff of Medford, Ore.; National Director Milton McGuire, and G. B. Schunke, Assistant Water Superintendent of the City of Seattle. President Howard attended the business meeting held on Thursday evening which was preceded by an informal buffet supper. Mr. Howard spoke to the group on the problems of national defense, particularly as they affected water works organization and operation. It was a splendid address and well received by a very attentive audience.

The buffet supper was an enjoyable affair where the superintendents sat down at round tables, partaking of the excellent food served by the hotel, and joining in an impromptu singing under the leadership of a wandering accordianist. The player strolled from table to table playing request numbers which everyone immediately took up and sang to the best of his ability.

The business meeting was presided over by the Chairman of the Board of Trustees who asked for a report by the National Director Mr. McGuire; a Committee Report on Short Course and Licensing; Nominating Committee; and the Secretary-Treasurer's report. The following officers were nominated for the year 1941–42: Fred Jones, Chief Meter Inspector of Spokane, as Chairman; Sam Watkins, City Water Superintendent of Aberdeen, Wash., as Vice-Chairman; C. V. Signor, City Engineer of Grants Pass, Ore., as Trustee replacing R. F. McLean, City Engineer of Walla Walla, Wash.; Tom Judd, Superintendent of Washington Water Power

(*Continued on page 16*)

OUT OF PRINT

Manual of Water Works Practice

Of the 6,143 copies of the first printing in 1925 and the three subsequent printings, none remains in stock.

STEEL PIPE *SCORES AGAIN!*

Unloading ARMCO Spiral Welded Pipe for a new water line in Cleveland. 50-foot lengths mean fewer sections to handle and fewer field joints.

Another recent Cleveland installation. Here ARMCO Pipe is being used for water circulation lines at the municipal light plant.

Cleveland Uses ARMCO Spiral Welded Pipe For Another Low-Cost Water Line

Once a city has experienced the benefits of ARMCO Spiral Welded Steel Pipe for supply and force mains, they are likely to reorder it again and again. Cleveland, the nation's sixth largest city, is a typical example. During 1940, as in previous years, this industrial center used ARMCO Pipe for important additions to its water supply system.

You can specify ARMCO "Spiral Welded" with confidence. Steel pipe has proved its durability, efficiency, economy in almost a century of service. Today, thanks to improved coatings, linings and manufacturing methods, an even better product is yours in ARMCO Spiral Welded Pipe.

With diameters from 6 to 36 inches, lengths up to 50 feet, and wall thicknesses for specific conditions, ARMCO Spiral Welded Pipe will meet every requirement. Consider its many practical advantages for that next job. Write today for prices and complete facts. The American Rolling Mill Company, Pipe Sales Division, 2231 Curtis St., Middletown, O.

ARMCO ARMCO **SPIRAL WELDED PIPE**

Steel Pipe . . . An Old Product Made Better • Meets AWWA Standard Specifications

(*Continued from page 14*)

Co. of Spokane, was held over as Trustee; Alex Lindsay, Water Superintendent of Spokane, National Director to succeed Mr. Milton McGuire. Secretary-Treasurer Fred Merryfield was re-elected. Eighty-four per cent of the members voted in the ballot election. The business meeting was conducted in a most efficient manner by Chairman Duff in the short period of 75 min.

The convention was opened with registration on Wednesday evening under the able help of B. C. Gosney, T. H. Judd and Claud Hall. Mr. Jarvis of Cashmere, Washington, registration chairman, was unable to be present due to illness. Through the able leadership of W. C. Morse, Chairman of the Local Arrangements Committee, a very efficient registration was conducted with little or no waiting in line by the members.

A new form of program was adopted. It was a simple, wirebound notebook 4 by 6¼ in., containing not only the program information, but tickets to the various affairs, and several pages of scratch paper. On the outside of the program was stamped the registration number and the man's name. In this way the program, if lost, could be returned to the registration desk for the owner. They cost a little more than the usual program,

(*Continued on page 18*)

Filter Sand and Gravel

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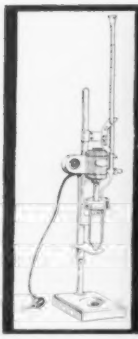

The Langelier Motorized Water Hardness Apparatus

For the rapid and convenient determination of Calcium and Magnesium separately or in combination.

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M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.

WATER-BORNE
OUTBREAKS
in the
UNITED STATES
and
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1920–1936

by
Arthur E. Gorman
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An unparalleled summary of studies concerning the relation of water supplies to typhoid fever, gastro-enteritis, etc.

A brochure that should be in the library of every sanitary engineer.

Price $1.00—postpaid if cash or check accompanies the order.

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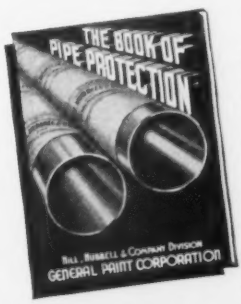
The HILL-HUBBELL "FACTORY PROCESS" means EFFECTIVE PROTECTION

The HILL-HUBBELL "factory process" gives MAXIMUM protection to "shatter-proof" STEEL PIPE because it applies Coating-and-Wrapping and Lining by the most EFFECTIVE method known today. The over-all cost is no higher, but the EFFECTIVENESS of application is MUCH greater.

Laying 85/8" O. D. Steel Pipe
Madison, Indiana



The Book of PIPE PROTECTION describes in detail how "shatter-proof" STEEL PIPE is MECHANICALLY Lined and Coated-and-Wrapped at the Mills under ideal conditions. Use your letterhead and write for a copy.

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- EXPORT OFFICE SAN FRANCISCO CALIFORNIA U. S. A. -

(*Continued from page 16*)

but were more valuable in every way, cutting down registration time and thus making a saving in the long run. [An excellent type of program. —Ed.]

The official program opened on Thursday morning. Honorable Earl Millikin, Mayor of Seattle, addressed the group in a welcoming speech to Seattle, and stressed the importance of national defense, and the checking of sabotage and saboteurs. The Mayor's speech was a fighting address to save American Democracy!

Mr. Hughes, the perennial Chairman of the Membership Committee, welcomed the new members, many of whom were present. The sectional membership is now one hundred sixty-three and three new members joined during the convention. The British Columbia group, members of the Canadian Section, were present and took an active part in the round table discussions and meetings.

One of the most interesting round table discussions was "Problems of a Small Town Water Superintendent" as explained by P. D. Wilson of Toppenish, Wash. Mr. Wilson, in a very humorous way, began the story with the Town Pump and carried it on to the modern water system.

A golf tournament was scheduled for those who love the game, while an inspection and sight-seeing tour was conducted for the members who were interested and had never seen the Seattle water system and shops.

George W. Gleeson, Professor of Chemical Engineering at Oregon State College, gave one of the outstanding discussions of the convention. (Prof. Gleeson's paper is published in this issue of the JOURNAL.)

(*Continued on page 20*)

Flash! Tenure Bill covering water and sewage works operators in New Jersey became law on June 28 by Gov. Edison's signature. The bulk of the work of carrying through the legislation was borne by Ed and Paul Molitor of the New Jersey Sewage Works Association. The complete text of the bill will be presented in next month's News of the Field.

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Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

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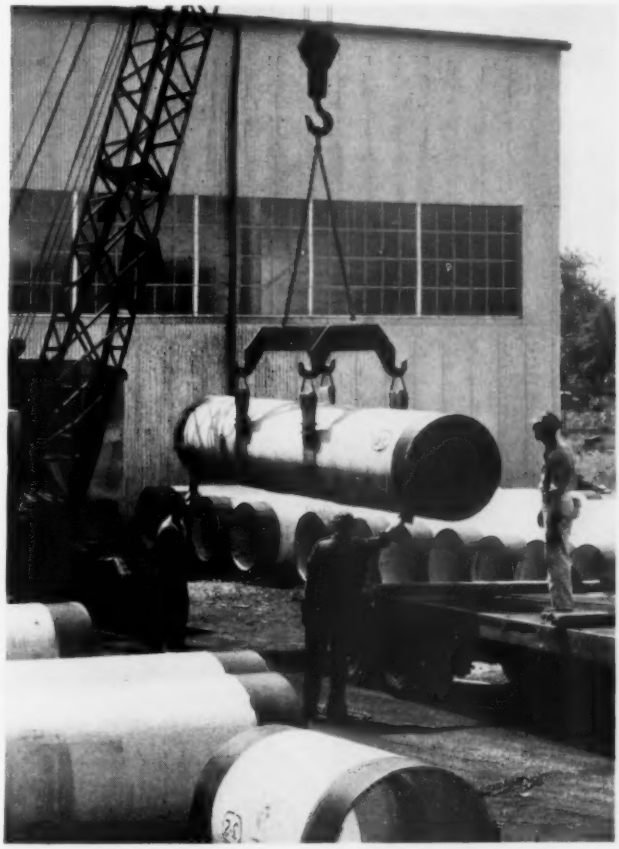

WELDED STEEL PIPE

The building of Chicago's new subway made necessary many changes in water mains, sewer pipes, cables, and ducts. All-welded steel pipe has been installed for a large amount of the relocated water mains. The above view shows several sections of it being loaded at our Chicago plant for delivery to the subway site.

Because of its high tensile strength and ductility, large diameter steel pipe is dependable when installed where it may be subject to shock or settlement. It can be made in long lengths and the welded joints are absolutely tight. The pipe shown here was coated inside and outside on a special coating machine.

Write for information and prices on large diameter steel pipe. Estimates will be given without obligation.

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(Continued from page 18)

W. C. Morse, with characteristic humor, gave a talk on the Seattle Water System by handing out a condensed, printed report.

The afternoon session, under chairmanship of Fred Jones, was carried out in round table discussions. Two of the committees reported: The Electrolysis and Grounding Committee with Mr. Northrup of Eugene, Ore. as Chairman; and the Safe Practice Committee with Chairman Brian Shera. The Safe Practice Committee, recently appointed, made a report giving interesting material that will be of great value in later years. Accidents reported for the year 1940 were analyzed as to type of accident, type of injury, operation in which injury took place, days lost, compensation received, and doctor's fees. The Safe Practice Committee should serve as a valuable bureau of information for the future, and it is felt that accident prevention can be furthered.

The evening banquet was presided over by Robert Duff and turned over to W. C. Morse who acted as Toastmaster. Four hundred and fifty members and guests sat down to a very enjoyable banquet which had been planned by Ed. Hallgren and committee. The decorations for the banquet were made by members of the Seattle committee and included a

(Continued on page 22)

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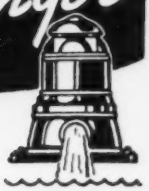

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TOWN OF LAKE, WISCONSIN

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Used **HTH** to sterilize million gallon system

● One of the most unusual municipal buildings in the country is located in Town of Lake, Wisconsin. What appears to be a "skyscraper" building is actually a concrete enclosed steel water tank . . . at the base of which is located the water department, softening plant, pumproom, and other offices pertaining to municipal management.

Designed by William D. Darby, consulting engineer, this modern waterworks is supplied by well water which is stored in the enclosed tank. The distribution system consists of 43 miles of mains of various sizes, and holds about 250,000 gallons when in static condition.

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(*Continued from page 20*)

beautiful floral display, and a lighted fountain set in a huge bowl of water lilies.

Ben Morrow, City Engineer of Portland, and Chairman of the George W. Fuller Award Committee, read out the award to William Hughes, City Engineer of Lewiston, Idaho. Mr. Hughes, who has been National Director for the Section, and Chairman of the Membership Committee for many years, has been extremely active in the water works field. His work for the city of Lewiston is a memorial to his genius and faithful work. President Howard gave an excellent address on the condition of world affairs. His sincere words were a source of inspiration to all those listening. Mr. Morse in his usual manner tried to carry on the program and at the same time give his talk which had been denied on Friday morning. Everyone enjoyed his wit and kind manner.

Gadget and Golf prizes were awarded by H. D. Fowler and Hugh Purcell, Chairmen of their respective committees. Several of the gadgets were unusual and there was considerable competition.

Saturday morning the outgoing and incoming Trustees met at breakfast. An inspection trip was provided by the City of Seattle and attended by approximately 200 people. The trip was made over the water shed on the Seattle River, and the Control Works and Chlorinating House at Lake Youngs were visited. An enjoyable luncheon at Shadow Lake, with Mt. Rainier in the background, brought a happy ending to a most enjoyable time.

Mention must be made of the fine manner in which the ladies of Seattle entertained the wives of visiting superintendents. The ladies were royally entertained with tea and at the theater.

In an effort to publicize the work of the water superintendent to the residents of the individual communities, the Publicity Committee obtained

(*Continued on page 26*)

Homer Rupard, 41, Principal Assistant Engineer of the Indianapolis Water Company, died on June 20, after an illness of only a few days. He was stricken at his office on June 17 and was taken first to his home and then to a hospital.

Mr. Rupard became associated with the Indianapolis Water Company in 1923. He was born in Kansas City, Kan., in 1899, and was graduated from the University of Kansas. He was an Active Member of the A. W. W. A. and will be remembered by JOURNAL readers as a valued contributor to the Abstract Section. He was also a member of the American Society of Mechanical Engineers, the Indiana Engineering Council, and the Air Conditioning Council of Indianapolis, and was President of the Indiana Society of Professional Engineers.

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(*Continued from page 22*)

names of the superintendents' local newspapers. Stories were written by this committee and the secretary's office and sent out to the newspapers. Mention was made in the particular newspaper about their superintendent's attendance and participation in the meeting. It is interesting to note that many comments have been received. It is hoped that this list of newspapers will be increased to include every town in the Northwest. In this manner news items of water works will be sent out and published through the local press instead of through the news services. It is to be hoped that the attention of the townspeople will be directed occasionally towards the water works superintendent who carries on his job 24 hours a day, 365 days in the year.

FRED MERRYFIELD
Secretary-Treasurer

Report of the Illinois Section Meeting

The Illinois Section opened its 33rd Annual Meeting on April 28 at the Hotel Lincoln-Douglas, Quincy, Ill. High spots of the meeting were: naming of Frank C. Amsbary for the Fuller Award, and the paper by C. W. Klassen, Chief Sanitary Engineer of the Illinois Department of Public Health, on "Water Supply Problems of the Manteno State Hospital Typhoid Fever Outbreak." Mr. Amsbary, Superintendent, Illinois Water Service Co., Champaign, received the Fuller Award "in recognition for his valuable services to the water works profession, the American Water Works Association, and the community in which he lives."

Officers elected for the ensuing year were: H. H. Gerstein, Chicago, Chairman; F. W. Hartmann, Chicago, Vice-Chairman; Clifford Fore, Carbondale, Trustee; Herbert L. White, Urbana, Trustee; Frank C. Amsbary, Champaign, Director; George B. Prindle, Highland Park, Past-Chairman; and H. E. Hudson, Jr., Chicago, Secretary-Treasurer.

Tribute was paid to William R. Gelston, father of the present superintendent at Quincy. Mr. Gelston, who passed away in September, 1940, was recognized by the Section as one of its leaders and stalwart supporters. The resolution stated: "He was possessed of the highest standards of honor and integrity, and his kindliness and consideration endeared him to all his fellow members."

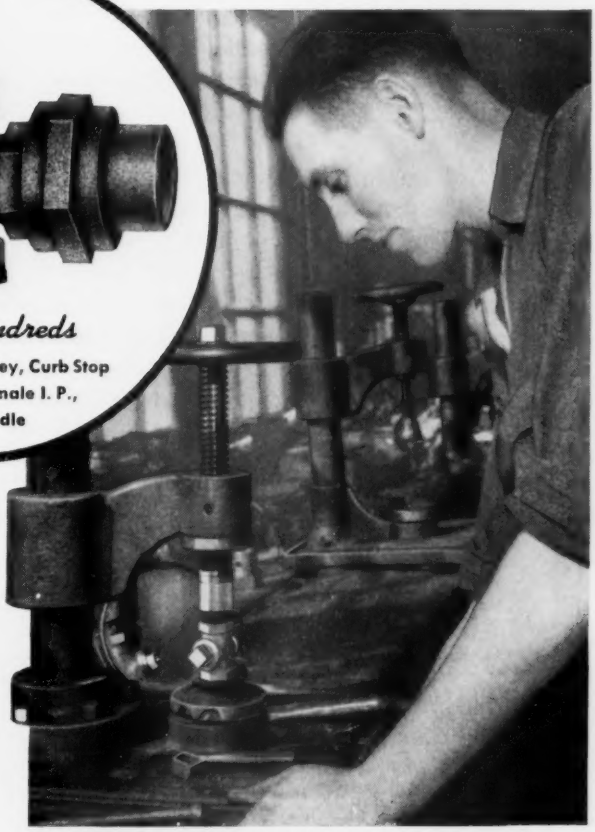
Resolutions were adopted condemning legislation repealing the existing right of municipalities to issue water revenue bonds without referendum, and approving legislation authorizing licensing of water works operators by the State. A bill giving the State Department of Public Health control over the quality and quantity of public water supplies was approved. A special resolution expressing appreciation for the co-operation of the manufacturers representatives was unanimously approved.

(*Continued on page 28*)

GOOD—FOR 200 LBS. PRESSURE

One of Hundreds

Fig 88A—Inverted Key, Curb Stop Lead Flange X Female I. P., Brass T Handle



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EVERY piece of Hays Water Works Brass is tested at 200 lbs. Hydrostatic or more, to assure water-tight pieces getting into your services. This 100% test is important to Hays too, for it serves as a constant check on foundry technique, saves us time and materials, helps to improve our product. You can depend on Hays Brass; that is why every piece carries the Hays trade mark, symbol and identification of a quality product. Write for Catalog No. 5 and further data.

(*Continued from page 26*)

The first gadget contest conducted by the Illinois Section found G. F. Stoldt, Jacksonville, winner for his device for measuring the growth of sand in filter beds treating encrustant water. The presentation was made by Clifford Fore of Carbondale, Chairman of the Gadget Committee.

The banquet on the evening of April 29th was preceded by a Fellowship Hour, during which the members rallied round for an old-fashioned get-together. Speakers at the Banquet were Norman Howard, A. W. W. A. President and Louis R. Howson, President-Elect. George B. Prindle presided and Paul Hansen served as Toastmaster. A floor show concluded the banquet.

A new feature for the Illinois Section was the Ladies Entertainment, which included trips to Mark Twain's Hannibal, Mo., home; to the former Mormon colony at Nauvoo; and a luncheon-bridge at the Hamilton Country Club.

Plans for the meetings were made by committees headed by the following: Program, H. H. Gerstein; Local Arrangements, W. R. Gelston, Jr.; Ladies Entertainment, Mrs. W. R. Gelston, Sr.; Banquet Entertainment, C. C. Abplanalp; and Fellowship Hour, W. A. Dallach.

(*Continued on page 30*)

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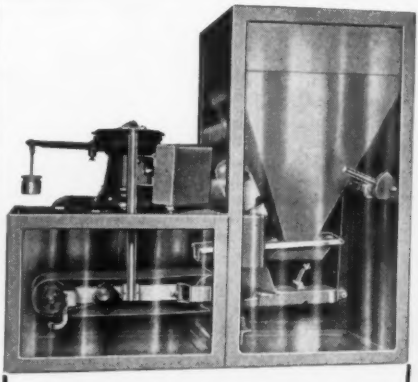

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eliminates all guess work—and feeds exactly the right amount—by weight

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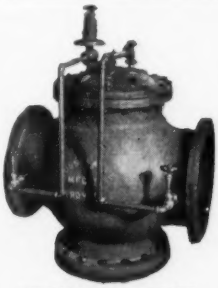

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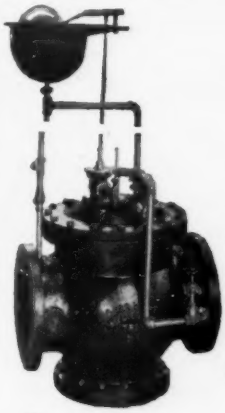

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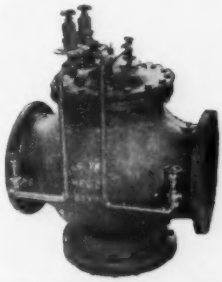

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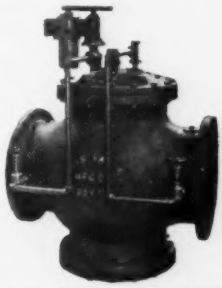

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(*Continued from page 28*)

R. E. Noble, Principal Bacteriologist of the Chicago Board of Health, gave a paper entitled "Should We Test Larger Portions of Water for Coliform Bacteria?" (Mr. Noble's paper is presented in full in this issue of the JOURNAL.)

C. C. Abplanalp, representative of Wallace & Tiernan, Inc., read the paper "Military Field Water Supplies" by Thomas T. Quigley, Engineer of the same company.

Horace R. Frye, Assistant Superintendent, Evanston Water Department, read a paper on "Protecting Water Works Structures Against Corrosion," limiting himself to discussion of protection of exposed iron and steel around the water works. Evanston has accurate records of corrosion protection. Elevated tank exteriors are protected by painting, with a thorough annual inspection and touching up of spots showing signs of corrosion. Submerged iron surfaces within an elevated tank were not protected for more than two years by any paint treatment, hence cathodic protection was installed in 1939. Mr. Frye discussed the principle upon which this method operates and mentioned difficulties which occurred due to ice formation in winter. Evanston is now trying an electrodeless system of cathodic protection but the results are not yet available.

(*Continued on page 32*)

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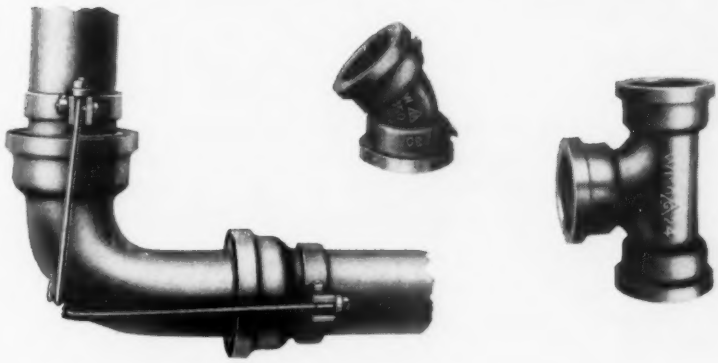

Leaking pipe joints mean expensive exploration . . . time and money wasted in repairs. Cut this unnecessary cost with Grinnell Socket Clamps. Joints are strengthened – all possibility of leaks eliminated. The steel clamps and rods are covered with durable protective coating. Grinnell Socket ¼ and ⅛ Bends are provided with convenient lugs for quick, secure installation. Grinnell Socket Clamps are available in a wide range of sizes and lengths – both Friction and Positive Types – to handle any joint and any size of fittings. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

SOCKET FITTINGS BY

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WHENEVER PIPING IS INVOLVED

(*Continued from page 30*)

"The Mystery of the Dirty Pool, or Why Be a Young Squirt" was the title (?) of a dissertation by George B. Prindle, affable Chairman of the Section and Superintendent of Water Works at Highland Park. After some comments on the disadvantages of cocksureness and the advantages of dubiousness, Mr. Prindle proceeded to describe some certain difficulties which he had experienced in the operation of a swimming pool in his own city. Bacterial results had indicated the continuous presence of organisms, confirmed by thiosulfated samples submitted to the State Department of Health. Chlorine had been applied at the filter inlet. Point of application was switched to the filter outlet and bacterial results were vastly improved. Residual chlorine was maintained at 0.5 p.p.m. at the pool outlet. Mr. Prindle was of the opinion that the thiosulfate in the sample bottles permitted the rapid multiplication of bacteria of samples mailed to the state capital, thus giving results far too high. He suggested that the thiosulfate may even feed the bacteria, asking verification of this hypothesis from Mr. Noble who replied, somewhat cautiously, "There is some evidence to suggest that possibility."

Mr. Gelston described similar experiences that he had had with thiosulfate samples at Quincy, and Mr. Kountz, of the Iowa Health Department, mentioned similar results at Iowa City. After a general round table discussion on swimming pool coagulation, or rather the lack of it, the meeting was adjourned.

What the salesman can offer an operator and what the operator expects from the salesman were the approaches of Edward E. Alt and L. A. Nalefski. (These papers, as prepared for the JOURNAL, were presented last month.)

Clyde C. Hunter, C.P.A. of Quincy, presented the next paper, "Recent Federal and State Tax Legislation Affecting Water Works." Prior to World War I, the tax situation hardly affected water works. The Wage and Hour Law now applies to private utilities. Sales taxes are applied on the purchase of tangible property by water utilities. Social Security laws in Illinois cover only Chicago and private companies. In both cases, unemployment benefits are provided. Efforts are now being made to extend Social Security provisions to independent contractors in Illinois. A bill is also before the legislature to extend the Wage and Hour Act to intrastate business. New federal taxes will soon strike every business and the excess profit tax particularly will affect private companies. In-

(*Continued on page 34*)

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MABBS RAWHIDE PACKING

on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

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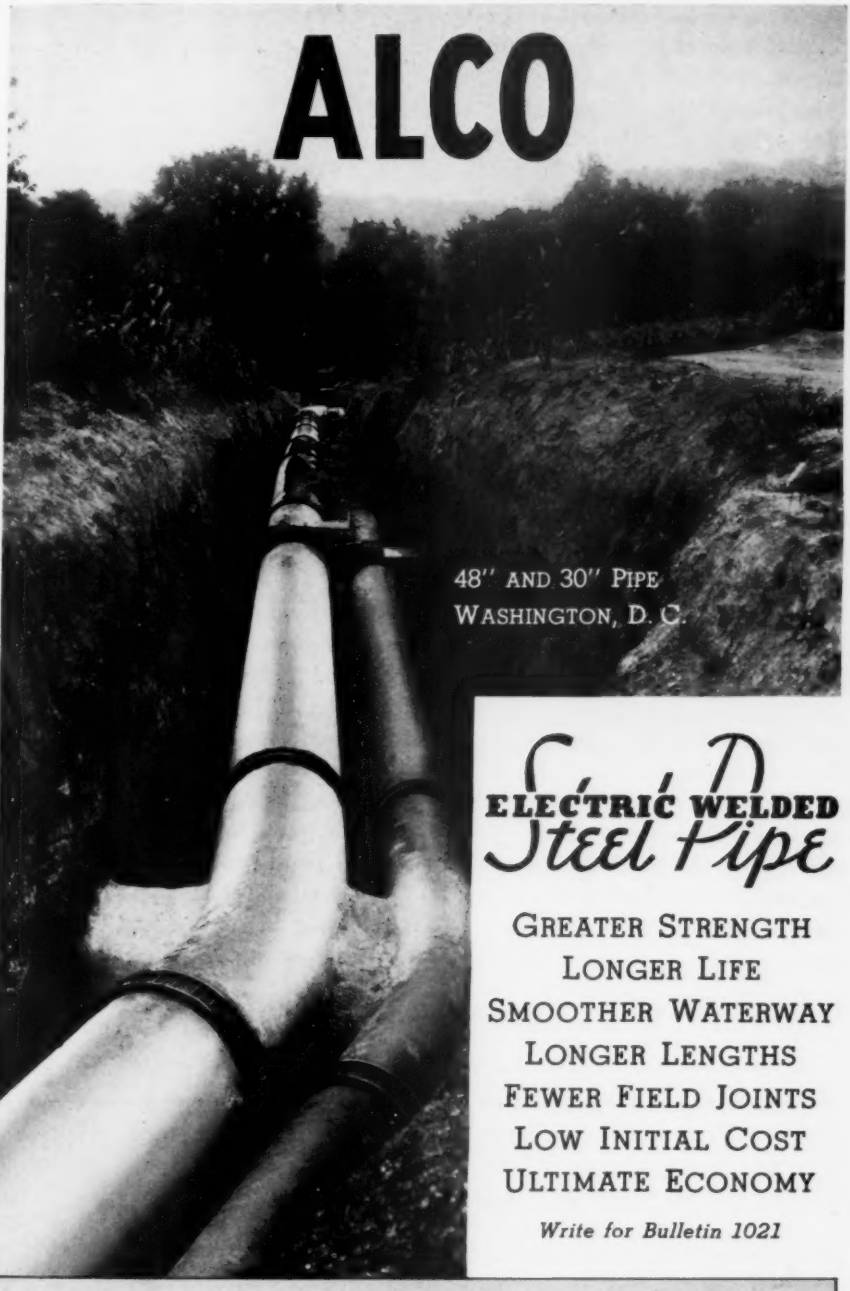

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(*Continued from page 32*)

come taxes will be increased on the salaries of employees, as will income taxes on corporations.

In a most carefully detailed paper covering the well-controlled and thoroughly-studied typhoid outbreak at Manteno State Hospital, C. W. Klassen showed step by step how the outbreak was clearly attributable to polluted water. This outbreak was the third largest reported since 1920 in the nation, and the largest to occur in Illinois. Adding interest to Mr. Klassen's material was the fact that the State Supreme Court had just ruled on April 16, 1941, that the presence of *Esch. coli* in water does not prove the presence of disease producing organisms, but rather that it tends to indicate the safety of the water. (This paper will be available very soon in the JOURNAL.)

A lively discussion followed this paper. Most of those participating expressed concern over the legal abandonment of the coliform test as indicative of water pollution. Some felt that the nullifying of the coliform standard could mean the abandonment of almost all bacterial requirements as to water quality. It was brought out clearly in discussion that the *Esch. coli* index was not on trial in this case. The courts were concerned rather with negligence on the part of an individual. Furthermore, the indictments forming the basis of the case were so drawn as to eliminate introduction of much of the evidence presented in the paper.

Charles H. Spaulding opened the first section of the Round Table, which was devoted to "Items Which Should be Considered in the Design of Water Treatment Plants From an Operator's Standpoint."

Willard Olson, Wilmette, briefly described cross-connections in the priming and water lubrication leads to centrifugal pumps. Location of the raw water meter should precede carbon application to prevent accumulation of sludge in the meters. Settled water level gages are often handy to assist in pump operation. Filtered water storage should be vented and designed to enable cleaning out sand and sediment. Standby power must be available.

F. L. Coventry, Mattoon, pointed out the need of a greater number of

(*Continued on page 36*)

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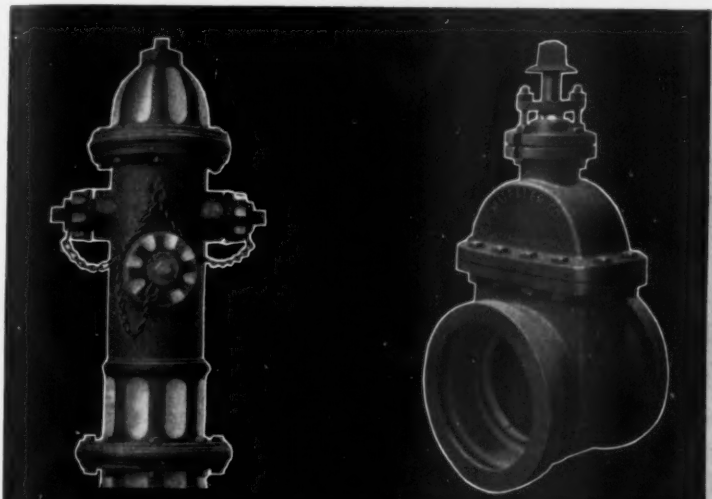
Steam Turbine Driven Pumps

The undersigned has for sale two steam turbine driven pumps with reduction gears. One is 10 M. G. D. at 200 foot head, the other is 10 M. G. D. at 50 foot head.

Address inquiries to **Walter A. Peirce, Manager**
Racine Water Department, Racine, Wisconsin.



MUELLER-COLUMBIAN

GATE VALVES

FIRE HYDRANTS

Mueller-Columbian Fire Hydrants have many exclusive features including the SELF-OILING TOP, the SAFETY-FLANGE SECTION and the ingenious MAIN VALVE ASSEMBLY. These are some of the reasons they are known as the low-cost maintenance hydrants.

Mueller-Columbian Gate Valves are the only valves that use the FOUR-POINT wedging principle by which the pressure is applied at 4 POINTS near the edges of the valve discs. This guards against sprung discs and insures a leak-proof valve.

MUELLER CO. CHATTANOOGA, TENN.

(*Continued from page 34*)

dry chemical feeders in most plants to give reliability of operation. Provision for sludge disposal needs more attention in design. More adequate CO_2 generation is often needed since absorption often does not exceed 60 per cent. A bypass from the filter effluents to the high lift pumps should be provided in case it is necessary to take the clear well out of service. Provision should be made for the movement of pumps and heavy machinery, possibly by the installation of a ring in the ceiling. John R. Baylis of Chicago seconded Mr. Coventry's plea for more chemical feeders, pointing out that there should be one spare for each chemical. Sludge disposal comprises a big problem for Chicago, he added, and must be carefully planned. A. M. Buswell, Urbana, pointed out that lime sludge is satisfactory for agricultural purposes, although it cannot economically be hauled more than fifty miles. At Chandlersville, according to Chief Sanitary Engineer Klassen, sludge disposal is accomplished by lagooning, with intermittent dynamiting which causes sludge disappearance. Clear wells ought to be provided in duplicate, said George B. Prindle.

We need flexibility, said Clifford Fore of Carbondale, to allow plant repair. Alternate intakes, independent settling basins, mechanical sludge removal, suitable bypassing, numerous points of chemical application are among the things which should be provided. Mixing velocities should be tapered, sludge return may be provided, chemical hoisting and storage facilities are needed and, most important, standby equipment should be provided at the very beginning. John Krause of LaGrange mentioned that a shower bath is a handy thing after handling plant chemicals.

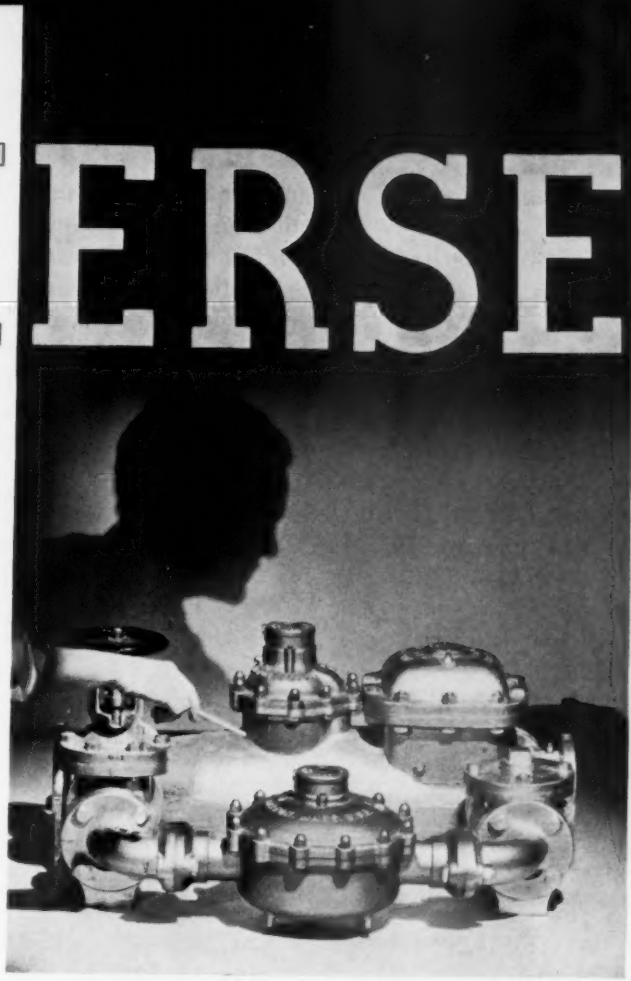
The small things are often forgotten, said Gilbert Ruston, Kenilworth. Convenient facilities for keeping the plant clean, for drainage, for tool storage, for painting and general maintenance are so frequently overlooked that the operator's work is much burdened by the need for attention to these subordinate details. Mr. Spaulding added that a complete file of manufacturers instruction often proves invaluable to the operator.

At Danville, said Martin Symons, dry feed machines have proven exceedingly troublesome. One has had to be entirely rebuilt. Intake flexibility is particularly important, he thought, and elevated storage is vital to insure service continuity, in case of plant shut down. J. J. Woltmann, Bloomington, pointed out that flexibility sometimes costs more than is available for plant construction. He agreed that more adequate tool storage, and mechanical aids to operation might well be provided. L. R. Howson added that money limitations usually held down provisions for flexibility.

The second half of the Superintendent's Round Table considered "Problems in Distribution Systems and Pumping Stations." A. E. Anderson of Moline pointed out that intakes are often located without regard to pollution of the raw water. Self cleaning screens may be helpful in débris-

(*Continued on page 38*)

HERSEY



WHEN ALL THE FACTS ARE KNOWN

the majority of Water Works Engineers do not hesitate to use or recommend the Hersey Detector Meter, because they know that it always delivers the full capacity of the supply pipe without jeopardizing the pressure, and further that Hersey Detector Meters have the full approval of the National Board of Fire Underwriters.

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA DALLAS — CHICAGO — SAN FRANCISCO — LOS ANGELES

(*Continued from page 36*)

laden supplies. Standby power for steam plant operation must be available for auxiliary equipment to forestall unexpected shut-downs. The steam header ought to be looped and valved to enable repairs without shut-downs. Maps and records of the distribution system ought to be supplied the operators of the system by the designers and constructors. The distribution system should be designed as a whole with valves carefully located. Valves should be in manholes with adequate clearance for workmen. Hydrants should be valved, particularly in high value districts. J. O. Fortin added that construction of oval manholes proved an economical means of providing working space.

John A. Pinner, Jr., Brookfield, described some amazing bulls in the design of a distribution system. The Brookfield plant was inadequately supplied by wells in the center of the town. A new source of supply was developed at the edge of town and connected into the old distribution system at this point without changing main sizes. The pressures in town now vary from 20 to 85 lb. The elevated storage tank has been rendered useless. No standby pumping was provided and a power interruption left the town without water. Instrumentation of power and water quantities is vital to allow a check on efficiency. Valves should be in a vault

(*Continued on page 40*)

DIFCO

Direct Plate Counts of Coli

Bacto-Brilliant Green Lactose Bile Agar

is an excellent plating medium recommended for direct counts of coliform bacteria in water. This medium conforms to the formula of Noble and Tonney as described in "Standard Methods of Water Analysis" 1936. After incubation for 18 hours at 37°C. typical colonies of coliform types are deep red and are surrounded by a pink halo.

Bacto-Violet Red Bile Agar

is a recommended medium for direct plate counts of the coliform organisms in water. On plates of this medium the coliform types produce red colonies surrounded by a reddish zone of precipitated bile. Counts are made after incubation at 37°C. for 18 hours.

Specify "DIFCO"

DIFCO LABORATORIES
INCORPORATED
DETROIT, MICHIGAN, U. S. A.

Water Meters

GREATLY REDUCE

Water waste!

What Water Meters Do

Greatly reduce water waste

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Keep down pumping costs

•

Conserve water reserves

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Distribute water costs fairly

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Reduce water rates

WHEN he knows he pays for all he wastes, the average consumer is careful about the water he uses. He will correct faulty plumbing, turn off water when he is through using it, and think twice before he lets it run for refrigeration and prevention of pipe freezing.

Recent evidence to this effect comes from Scottsburg, Indiana. There, by 100% metering, along with an educational program, their pumpage was reduced 30%.

Trident Water Meters

Are thoroughly dependable in design, construction, operation

Have interchangeable parts, minimizing maintenance, avoiding obsolescence

Have established new standards of accuracy in testing on low flows, whether new or repaired. Of the plus 6-million made and sold, the great majority are still in service.

The SYMBOL of SUSTAINED ACCURACY

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Neptune Meters, Ltd., 345 Sorauren Avenue, Toronto, Canada

1

• *One of a series of advertisements outlining the five ways in which Water Meters increase operating efficiency, reduce costs and add to the revenue of the modern Water Works.*

(*Continued from page 38*)

and located to allow shutting down small portions of the distribution system. Hydrants ought to be valved to permit shutting off promptly in case of damage by a truck. The design of a water works needs to be viewed as a whole, and with the aid of the operator from the start.

Notes by H. S. Merz of Rockford were read by William Downer, Springfield. In steam pumping stations coal storage in bins, dust prevention, convenient ash removal, equipment accessibility, drainage and electrical outlets, and metering equipment are very often neglected. In electrical stations, the operator needs duplicate power sources, adequate metering equipment, electrical heating of small stations and rubber gasketed mechanical jointed piping for ease of equipment repair.

At the afternoon session, attendance varied between 60 and 70.

The report of the Committee on Control of Well Drilling was presented by the Chairman H. L. White, Sanitary Engineer, University of Illinois, Urbana. In a preface to the report, Mr. White mentioned the widespread desire for information from state agencies on ground water supplies; the depletion of private, farm, and public well supplies; the ineffectiveness of existing permit methods both in securing complete registration of wells and in recording well characteristics; new construction of industrial wells;

(*Continued on page 42*)

FILTER SAND

99 Per Cent Pure Silica Washed, dried and manufactured to your specifications

Write for Prices on Bulk, Carload or Bags

Dawes Silica Mining Co.
Thomasville, Georgia

Peerless Pumps

—AS THEIR NAME IMPLIES

Acknowledged leaders in their field

HI-LIFT, TURBINE & HYDRO-FOIL

TYPES—capacities up to 100,000 g.p.m.

Ask for Literature

PEERLESS PUMP DIV. - *Food Machinery Corp.*

Factories: Los Angeles, San Jose, Fresno, Calif., Canton, Ohio

3 *Money, Time and Labor Saving Features of*

UNIVERSAL
CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.

For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

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THE CENTRAL FOUNDRY COMPANY
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Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

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SMOOTH BARRETT LININGS

hold the coefficient of flow HIGH!

Kankakee Ordnance Project

THE experience of waterworks engineers the country over points to Barrett Waterworks Enamel as a sure means of maintaining capacity at an efficient level. The easy flowability and fine structure of these protective coatings result in an unusually smooth interior surface.

Barrett Enamels are also highly dielectric, guard against water absorption and resist mechanical distortion. They meet the American Water Works Association's standard specifications 7A.5 and 7A.6 (1940).

They are produced from the most durable bituminous material known for pipeline protection, and manufactured according to strict Barrett standards. The assistance of Barrett-trained field men is available to engineers on all jobs for which Barrett Enamels are specified.

Barrett WATERWORKS ENAMEL

FIELD SERVICE—The Barrett Waterworks Service Department and staff of Field Service men stand ready to provide a broad measure of cooperation. These services include consultation on technical details, training of crew, and job inspection.

THE BARRETT COMPANY • 40 RECTOR STREET • NEW YORK, N. Y.

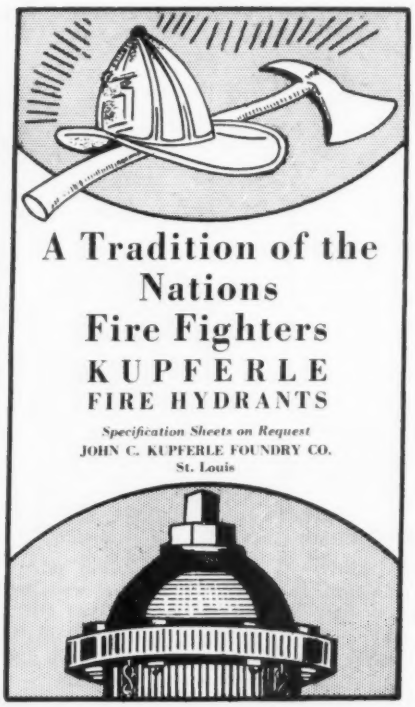
(*Continued from page 40*)

abandonment of unsealed wells; effect of current well drilling practice on health; and the effect of air conditioning on ground water quantities and sewage flows.

Following the presentation of this background material, the report of the committee discussed: (1) collection of adequate data for use in the proper development of ground water resources; (2) the need for conservation of ground water; and (3) the need for protection of public health. The committee recommended that a standing committee of the Illinois Section be appointed to give the matter of ground water resources continued study in order that recommended legislative action may be suggested from time to time. Also recommended was the preparation of a bill to permit the transfer to the State Department of Public Health the duties now assigned to the State Department of Mines and Minerals with respect to the construction and maintenance of water wells.

Paul Hansen's paper, "Water Supply in Relation to National Defense" opened the session on national defense. Mr. Hansen emphasized the effect of greatly increased war industries on water supplies, possibilities of sabotage and of bombing of cities from the air. He pointed out that the protection of water supplies is now being extensively studied. War

(*Continued on page 44*)



Said the Pigmy to the Giant:
"Don't cok down on me, Big Boy. It takes all kinds of folks to make a world."
Likewise it takes *all sizes* of pipe to make a *complete* line. Acipco not only furnished the largest centrifugal Cast Iron Pipe in America (48") but also is a pioneer developer and one of the industry's largest producers of Cast Iron Pipe in the smaller diameters (1½", 2" and up.)
Pipe 3" and larger are manufactured by the Mono-Cast Centrifugal Method. Complete line of fittings. For detailed literature address Acipco office nearest you.
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That EXTRA Something

YOU'LL NOTICE IT THE DAY YOU START USING THESE

Acclaimed ACTIVATED PRODUCTS

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STANDARD ACTIVATED ALUM
ACTIVATED BLACKALUM
CHAMPION ACTIVATED CARBON
CHLORINATED BLEACHING CLAY
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Their dependability of performance is traditional... is it any wonder that these fine products are ***BEING ENTHUSIASTICALLY RECEIVED*** by the waterworks profession . . . ***EVERYWHERE ?***

Everybody Likes Activated Alum

May we remind you again that we are exclusive agents for the Tate Pipe Lining Process . . . the rejuvenation treatment which will restore, preserve and even increase the carrying capacities of your pipe lines for years to come.

Activated Alum Corp.

Office
5701 Pennington Ave.
Baltimore, Md.

Works
Curtis Bay
Baltimore, Md.

(*Continued from page 42*)

industries have placed enormous demands on water resources and cantonments require large water supplies. He listed a large number of defense establishments in Illinois whose works are systematically visited and supervised by the State Department of Health. Sabotage possibilities can be obviated largely by good management as well as by adoption of certain specific methods. Dams and reservoirs are particularly vulnerable, as are wells of large yield, long conduits, intakes, pumping stations, filter plants and chlorinating equipment. The prompt, sane and systematic review of water works by their respective managements is important.

"Protection of Water Works Against Sabotage" was the title of the paper by Joseph Horn, special agent of the F. B. I. Mr. Horn outlined the rôle of the F. B. I. in the civil defense program and then proceeded to outline ways in which a saboteur may seek to destroy water service. He discussed the methods of espionage followed by spies at the present, and indicated safeguards against foreign control sabotage. Personnel is the most vital point in protection. Plans should be carefully guarded. Guards should be schooled. Protection against fire, bombs and explosives must be planned in advance.

At the close of Mr. Horn's paper, Paul Hansen moved that the Illinois

(*Continued on page 46*)

Cathodic Protection

The only positive method of preventing rusting, pitting and corrosion in steel water containers.

THE PATENTED

RUSTA RESTOR TRADE MARK REGISTERED

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METHOD

Steel Water Tanks
Filter Beds

For complete details write

RUSTA RESTOR CORPORATION

1440 W. State St., Fremont, O.

IN YOUR BELL AND SPIGOT JOINTING

Slow sealing of that initial leakage delays backfilling of trenches and clearing up of traffic hazards that go with construction work • Cut this bottleneck by using quick-sealing *Tegul*-MINERALEAD • This sulphur-base, ingot form compound delivers everything you expect from any other good compound and, in addition, gives you quick sealing, ease of handling, . . . is inert to jolting in transit (apt to cause composition changes in some compounds) and impervious to rain and flood when stored outdoors • Joints made with *Tegul*-MINERALEAD are permanently tight, much more than ordinarily flexible and have higher resistance to thermal and mechanical shock and vibration • You'll find Tegul-MINERALEAD a money-saver too • Glad to send you more information. Write The ATLAS MINERAL Products Company of Pa., Mertztown, Pennsylvania.

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CAST IRON PIPE

Manufactured in Sizes 2" to 96"—
A large stock constantly on hand,
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PHILLIPSBURG, N. J.
EVERETT, MASS.

(*Continued from page 44*)

Section appoint a Committee to contact the National Association regarding the formation of a committee to act in an intermediary capacity between water works men and various federal agencies (such as the F. B. I. and the Army) in regard to the defense of water works plants. This committee should furnish information for the federal agencies and form the liaison agency between the government and the plants. The action is to be subject to review by the Board of Trustees. The motion carried, and on query from the Chairman, Mr. Hansen agreed to serve as chairman of the initiating committee.

Norman J. Howard of Toronto was unable to be present and his place was taken by W. W. Brush of New York, who described bombing damage in England and Barcelona.

Charles B. Burdick, Consulting Engineer, Chicago, spoke on "Building Cantonment Water Supplies Under Difficulties." Time was the essential factor, he said. Most of these water supplies were built in about one-sixth of the normal construction time and construction began during the worst season of the year. The new cantonments are more permanent than the 1917 installation and are built further from large cities owing to the need of space for maneuvers of mobile equipment.

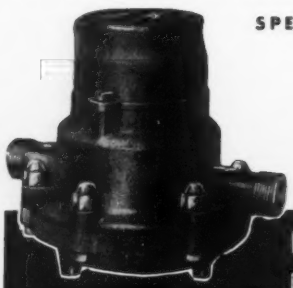
H.E. HUDSON, JR.
Secretary-Treasurer

Apropos of R. F. Goudey's paper on cross-connections in the March, 1941, JOURNAL, E. Sherman Chase, Chairman of the A. W. W. A. Committee on Cross-Connections, has submitted the following excerpt from a report made in 1876. He says, "It would indicate that the dear old State Board of Health of Massachusetts, as usual, was 'firstest' on the ground although perhaps not the noisiest:"

"It has been usual with many plumbers of late to recommend the flushing of water-closets of the common 'pan' or 'hopper' style by a valve to be opened in a branch of the main water-supply of the house, from which drinking-water is drawn through another faucet. But the only safe way

(*Continued on page 48*)

FIRST QUALITY METERS EXCLUSIVELY



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(BRONZE CASE) (IRON CASE)
Water Meters
WRITE FOR CATALOG

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.

CLEAN YOUR WATER MAINS

One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

National Water Main Cleaning Co.

30 Church St., New York, N. Y.

BRANCHES

115 Peterboro St., Boston, Mass.
910 William Oliver Bldg., Atlanta, Ga.
7103 Dale Ave., St. Louis, Mo.
406 Florida Theatre Bldg., Jacksonville, Fla.
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STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains—under paved streets, railroads or over bridges—you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 30 Church Street, New York, N. Y.
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A Symbol of Quality

HYDRO-TITE

Reg. U.S. Pat. Off.

A DEPENDABLE SELF - CAULKING JOINT COMPOUND

(Continued from page 46)

is to break this connection by providing a small tank and service-box for the closet. With the valve furnishing water direct from the main, the following risk is incurred: The water-supply, even though nominally 'constant,' is sometimes shut off temporarily for repairs in the street, and if at such time the water-closet valve should be opened, the air is drawn rapidly into the water-pipes from the interior of the closet, which is filled with organic vapors, and perhaps with actual contagium from disease. The water is soon let into the pipes again, mixing with this air and dissolving a portion, thereby becoming contaminated and unfit for drinking. This direct connection-valve has become so popular that one of the prominent dealers in plumbers' supplies recently alluded to the service-box supply as an 'old-fashioned way which was going out of use,' while conversing with the writer.

"In the supplementary report of the medical officer of the Privy Council for 1874, there is an interesting report from Dr. Buchanan, upon an outbreak of enteric fever in Caius College, Cambridge, where fifteen students were attacked while living in a building which was supposed to be provided with the most perfectly arranged sanitary appliances. After a most painstaking investigation, the fever was traced, by convincing evidence, to the use of a water-closet with direct supply from the mains, which had poisoned the water used for drinking in precisely the manner indicated above. In the same report, the following extract is found from the regulations under the metropolis water act of 1871: 'These regulations having for their object the preventing of undue consumption or contamination of water, are the result of an inquiry made for the Board of Trade by Lord Methuen, Captain Tyler, and Mr. Rawlinson, C. B. They have the sanction of the Board of Trade, and may be put in force by the London water companies.'

" 'Every boiler, urinal and water-closet in which water supplied by the company is used (other than water-closets in which hand-flushing is employed) shall, within three months after these regulations come into operation, be served only through a cistern or service-box, and without a stool-cock, and there shall be no direct communication from the pipes of the company to any boiler, urinal or water-closet. No pipe by which water is supplied by the company to any water-closet shall communicate with any part of such water-closet, or with any apparatus connected therewith, except the service-cistern thereof.' "

COOK Well Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

A. D. COOK, INC.
Lawrenceburg - Indiana

COOK Deep-Well Turbine Pumps

News of the Field

The National defense program is undoubtedly affecting every phase of water works activities. It would appear that, while American citizens know that cantonments have been built, men have been drawn into military training and a tremendous program of equipment and arms manufacture has been undertaken by the United States military authorities, some occasionally do not appear to feel that this program should be expected to have an effect upon their own activities. It likewise appears that those in charge of the national military production program are less forthright than they might be in laying down outlines of procedure that would be of assistance in making people understand just what things people can be expected to carry on and what activities can best be put aside "for the duration."

Since the Toronto Convention, the American Water Works Association's Committee on Defense has met, has developed certain contacts with Washington authorities and is doing its best to obtain a clearer picture of the limitations which are bound to affect water works activity. The O.P.A.C.S. has issued its order setting up a critical list of civilian activities and has indicated that repair and maintenance requirements for these special industries "shall be entitled to allocation of materials prior to all other civilian requirements and prior to defense to the extent consistent with the defense program as determined by the Office of Production Management."

The Office of Production Management is momentarily expected (July 31st) to release the announcement that will put this policy into effect. In the meantime, several manufacturers of water works construction and equipment items have been finding it difficult to obtain materials from which they fabricate their water works products and are asking that orders placed by water works men show a definite relation to some defense project and that a preference rating be obtained to cover the material required by the order.

The Office of Production Management in April issued a booklet entitled "Priorities & Defense." It is a handbook on the operation of the priorities system and should be obtainable either through any branch office of the O.P.M.; from the Information Division for Emergency Management in Washington, D. C.; or the U. S. Government Printing office in Washington, D. C. The booklet carries no record that any charge is made for it.

Some water works men do not seem to understand that the addition of the defense production program is bound to produce a dislocation of ordinary civilian activities. There appears from time to time, the idea that since public water supply is an essential public service and on the pre-

(Continued on page 2)

(*Continued from page 1*)

ferred civilian list of the O.P.A.C.S., water works orders should be handled without any delay and without any more formality than was customary years ago. No one should delude himself with that sort of idea even though public water supply is recognized as a primary civilian service. There are some aspects of water supply procurement that are going to have to wait their turn. If a defense industry or project suddenly increases the demand upon a water department, that department, if it clearly states its case, will get preferential treatment. Repair and maintenance of water works structures will be taken care of by the special department set up in the O.P.M. But, if the material a department wants to buy is not related to defense expansion or is not designed to repair an already existing unit, careful consideration should be given to the situation before one gets excited about the manufacturer who does not readily promise to deliver the goods that are required.

There is another phase of the matter that needs to be given thought. Water works operating materials may tend to be less easily obtained but no one in authority in Washington has any idea that water works operators are to be deprived of materials needed to operate so that the public water supply will be safe and adequate. With that in mind, operators should co-operate with producers and not insist upon a particular sized package when the situation at the moment makes it necessary for the manufacturer to produce the goods in some more conveniently sized package. Nor should departments be overly precise in special requirements for water treatment materials. The Association's Board of Directors will shortly have to consider the question of how to suspend parts of current A.W.W.A. specifications when it is shown that the manufacturer cannot obtain the various special treatments or types of material required by the basic specifications.

This is the time for a combination of tolerance and devotion to fundamental objectives. Water works men have been trained for generations to bend their energies toward the attainment of the fundamentals—an adequate water supply for every water using citizen; a safe water supply;

(*Continued on page 4*)

OUT OF PRINT

Manual of Water Works Practice

Of the 6,143 copies of the first printing in 1925 and the three subsequent printings, none remains in stock.

WHERE TUBERCULATING WATERS MUST BE TRANSPORTED

(LESS THAN 25% OF THE U. S. A.)

USE LINED CAST IRON PIPE*

THE areas of the United States where tuberculating waters materially affect the carrying capacity of pipe represent *less than one-quarter of the total area of the country*. If you are located within one of these areas, use *lined* cast iron pipe. You do *not* have to sacrifice the long life, low maintenance cost and salvage value of cast iron pipe in order to be assured of high carrying capacity throughout the life of the pipe you buy. The Cast Iron Pipe Research Association recommends *lined* cast iron pipe where tuberculating waters must be transported. Lined cast iron pipe is the only pipe that will have 100 years of useful life plus 100 years of high carrying capacity. Send for map which shows approximately 76% of the country where little or no tuberculation is to be expected. Lined cast iron pipe is made in sizes from 1¼ to 84 inches.

**Various types of linings are available to meet various conditions and preferences of users.*

Look for the "Q-Check" Registered trade mark.

The Cast Iron Pipe Research Ass'n, T. F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago, Ill.

CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

and a supply sufficient in quantity at the time of emergency to protect against conflagration. In addition to these fundamental objectives, the field has consistently been striving for improvement of its services. An infinite number of details have crept into water works practice. Some of these detailed requirements and procedures may have to be suspended temporarily in the interest of the defense of the nation as a whole. The Association's officers will support the cause of public water supply to the end that its essential features be preserved and the public be adequately and safely served. That should be what every good citizen wants.

Priority status for repair and maintenance materials and equipment required for uninterrupted operation of a wide range of industrial processes and public services was assured at the first of July when the Civilian Supply Allocation Division of the Office of Price Administration and Civilian Supply promulgated an allocation program covering such items.

Action was necessitated by growing demands on raw materials as a result of the defense program and the priorities granted in connection therewith which have made it difficult for manufacturers of repair and maintenance materials and equipment to fill their orders. Effect will be to assure continued operation of essential industries and services which otherwise might have to curtail because of inability to secure needed repair or maintenance parts.

The program covers 26 industries and services whose continued operation is essential to the public welfare and maintenance of civilian supplies. Other industries will be added when their problems have been analyzed. The program provides that such materials and equipment shall be allocated prior to all other civilian requirements and prior to defense requirements to the extent consistent with the defense program as determined by

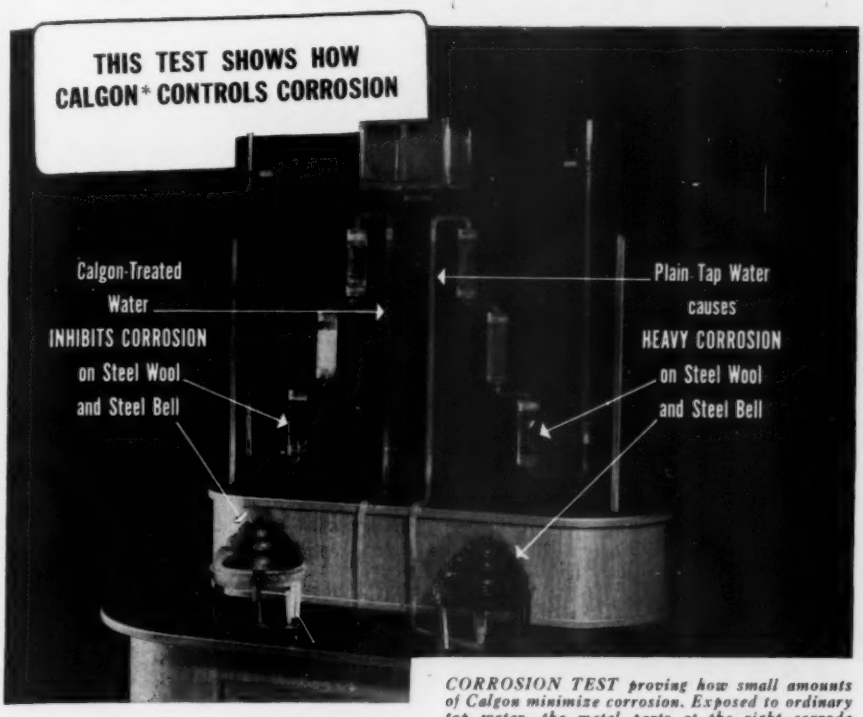
(*Continued on page 6*)

D. Arnold Lane, who for many years had been in charge of underground water development and hydrologic studies for the Los Angeles Bureau of Water Works and Supply, died on July 1 at the age of 44.

Mr. Lane was born in Boise, Idaho, but came to Southern California in his youth. He had attended Glendale High School and the University of Southern California before his service with the Los Angeles Department, which was to last over a period of 25 years. He was well known for his studies on underground water conservation and as an expert on water right litigation. He inaugurated the publication of "Your Garden," a pamphlet for home gardeners distributed to all Los Angeles water consumers.

Mr. Lane had been an Active Member of the A. W. W. A. for the past 10 years. He was past secretary of the Los Angeles section of the American Society of Civil Engineers.

Is there a Skeptic in the house?



CORROSION TEST proving how small amounts of Calgon minimize corrosion. Exposed to ordinary tap water, the metal parts at the right corrode rapidly, are soon covered with rust. With Calgon Treatment during the same period, however, corrosion on metal parts at left is negligible, rusting barely discernible.

• • •

CALGON'S ability to control corrosion was impressively demonstrated at the recent A.W.W.A. Convention. The most skeptical water works official could see for himself that minute quantities of Calgon do inhibit corrosion to an extent no one believed possible a few years ago.

When an operator looked at the unit on the right—where corrosion by *untreated* water was building up the all-too-familiar rust on the steel wool and steel bell—he could hear the telephone buzzing with complaints of "red water."

When he turned to the unit on the left, his first reaction was that it must all be a trick—unless he was one of the fast-growing group of men who already *know* what Calgon treatment will do in actual practice.

To the operator unacquainted with the potent action of Calgon, seeing became believing as the steel of the bell remained bright and the steel wool clean. Here was the answer to his corrosion problem!

Calgon not only controls corrosion but prevents precipitation of dissolved iron, so that red water from either source is easily eliminated. Usually only 1 or 2ppm. of Calgon are necessary.

Calgon treatment is inexpensive, and the new low price, made possible by greater demand, now makes it even more attractive.

Calgon, Inc.
300 Ross St., Pittsburgh, Pa.
Gentlemen:
Please send free sample and data on:
Corrosion Control ☐ Scale Prevention ☐
My problem is .....
Name .....
Affiliation .....
Address .....
City ..... *State* .....

SEND FOR FREE SAMPLE. *Conduct a test in your own laboratory and prove to yourself why more than 200 cities are now using Calgon successfully.*

**Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products.*

calgon, inc.
300 ROSS ST PITTSBURGH, PA

(*Continued from page 4*)

the Office of Production Management. Administration and enforcement of the program will be carried out by the O.P.M.

Text of the program including the list of industries and services covered is as follows:

Title 32—National Defense
Chapter XI: Office of Price Administration and Civilian Supply

Part 1318—Materials and Equipment Used in Maintenance and Repair Work

Civilian Allocation Program for Materials and Equipment Used in Maintenance and Repair Work

"Increasing demands from all sources and the priorities granted to defense requirements have made it difficult for other enterprises to obtain materials and equipment needed for purposes of maintenance and repair quickly enough so that essential operations can be maintained without interruption. It is necessary, therefore, to provide priority status for the materials and equipment required to maintain such existing facilities in a satisfactory operating condition.

"Furthermore, in cases where unforeseeable breakdowns occur and the

(*Continued on page 8*)

For Underground Service Lines

ANACONDA COPPER and RED-BRASS

Anaconda Copper Tubes in straight lengths and coils... Anaconda "85" Red-Brass in straight lengths only — both are products of dependable quality. Made by the world's largest and most experienced manufacturer of copper and brass, and stocked by leading supply houses.

3924

THE AMERICAN BRASS CO.
General Offices: Waterbury, Connecticut

WITH THIS COMPOUND

PIPE JOINTING TROUBLES FADE AWAY

Tegul-MINERALEAD requires no skilled labor, caulking or deep bell holes The work is speeded since initial leakage seals almost at once, permitting immediate backfilling and clearing up of the premises • Also, there are no delays when melting pot needs replenishing • Joints are permanently tight and withstand far greater vibration and thermal and mechanical shock than they'll ever meet in service • Write for more information about this different, ingot form bell and spigot jointing compound. The ATLAS MINERAL Products Company of Pa., Mertztown, Pennsylvania.

Tegul- MINERALEAD

HOW TO KEEP YOUR PLANT GOING WITHOUT INTERRUPTION!
PLEASE PASS ALONG
PIPING POINTERS TO KEEP EQUIPMENT ON THE JOB!
CRANE
AN AID TO DEFENSE

HERE'S A NEW CRANE SERVICE

TO HELP YOU AVOID PLANT INTERRUPTIONS

Crane announces publication of a new series of Shop Bulletins designed to help you train new maintenance men and improve the work of veterans. Bulletin No. 1 is now ready. It covers workmanship—shows a lot of practical hints on how to install and service piping equipment.

Ask your Crane Representative—or write us—for copies to be distributed among your maintenance force.

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE • PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

(Continued from page 6)

need for equipment and materials becomes acute, a very high level of preference is required.

"Accordingly, pursuant to and under the authority vested in me by Executive Order No. 8734, particularly Section 2(a) thereof, the following program for the allocation of materials and equipment for maintenance and repair of facilities employed in non-defense operations is announced:

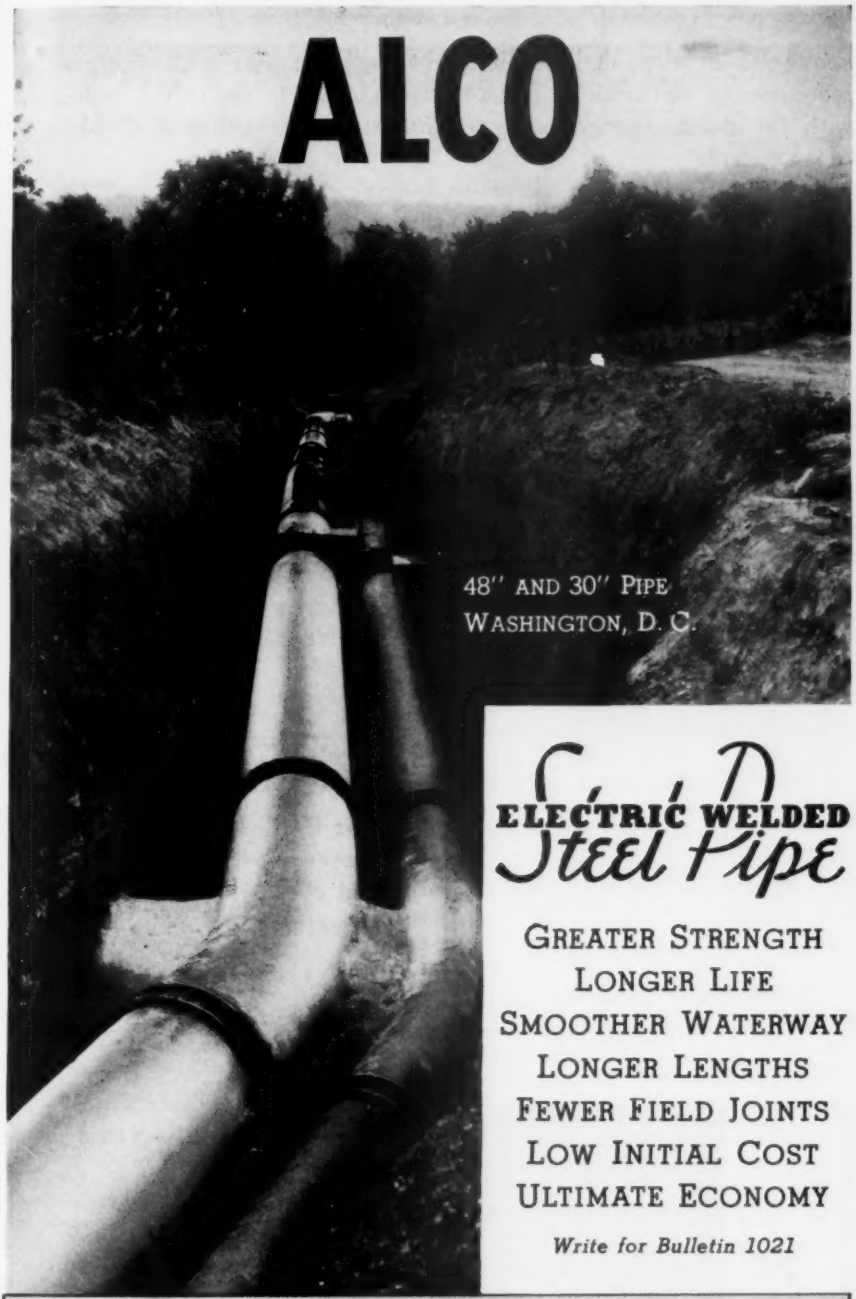
"S1318.1 *Allocation of Materials and Equipment for Maintenance and Repair.* Materials and equipment necessary for the maintenance and repair of facilities employed in operations in the following classifications shall be allocated to such use prior to the satisfaction of other competing civilian demands:

"Railroads
Street railway, subway, elevated, and interurban lines
Commercial airlines maintaining regular scheduled service
Commercial operation of motor buses—local, interurban and interstate
Shipping—including ocean, lake, river and canal commerce
Pipe lines—oil and gas
Commercial operation of motor trucks
Highway maintenance
Telephone communication
Telegraph communication
Radio commercial communication—including commercial broadcasting
Electrical energy production and distribution
Gas production and distribution—manufactured and natural
Water production and distribution
Sewer service
Petroleum production and refining
Food processing and storing
Farm equipment employed in farming operations
Mining and Quarrying
Coke converting
Metallurgical plants engaged in the production of raw materials
Production of chemicals
Protective services—fire and police
Research—industrial and academic
Hospitals, clinics and sanatoria
Public buildings, institutions, schools and parks.*

"S1318.2 *Emergency Maintenance and Repair.* Materials and equipment necessary for emergency maintenance and repair of facilities in the

*S1318.1 to 1318.5 inclusive, issued pursuant to the authority contained in Executive Order No. 8734.

(Continued on page 10)



ELECTRIC WELDED
Steel Pipe

GREATER STRENGTH
LONGER LIFE
SMOOTHER WATERWAY
LONGER LENGTHS
FEWER FIELD JOINTS
LOW INITIAL COST
ULTIMATE ECONOMY

Write for Bulletin 1021

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(*Continued from page 8*)

above classifications shall be allocated to such use prior to all other civilian requirements and prior to defense requirements to the extent consistent with the defense program as determined by the Office of Production Management.*

"S1318.3 *Avoidance of Excessive Inventories.* Allocations made under this program shall not be used to accumulate excessive inventories, or to divert parts still serviceable.*

"S1318.4 *Definitions.* As used herein, the term 'maintenance' means the upkeep of property and equipment, and the term 'repair' means the restoration of property and equipment to a sound state after wear and tear, damage, destruction of parts, or the like. These terms include replacement of parts which have been worn out, damaged or destroyed, but do not include replacement when the new part or parts represent a change-over in model, the introduction of superior type equipment to replace usable equipment of an older or inferior type or design, or a substitution more extensive than that which is necessary to replace the part or parts that are worn out, damaged or destroyed.*

"S1318.5 *Enforcement.* The foregoing program is to be administered and enforced by the Office of Production Management.*"

(*Continued on page 13*)

Filter Sand and Gravel

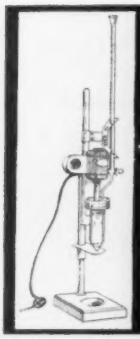
WELL WASHED AND CAREFULLY GRADED TO ANY SPECIFICATION.

PROMPT SHIPMENT IN BULK OR BAGS OF 100 LBS. EACH.

Inquiries Solicited.

Northern Gravel Co.

P. O. Box 307, Muscatine, Iowa



The Langelier Motorized Water Hardness Apparatus

For the rapid and convenient determination of Calcium and Magnesium separately or in combination.

Write for descriptive folder

Chemlab Specialties Co.

52 Alvarado Rd., Berkeley, Cal.

Cathodic Protection

The only positive method of preventing rusting, pitting and corrosion in steel water containers.

THE PATENTED

RUSTA RESTOR TRADE MARK REGISTERED

PATENTED & PATS. PEND.

METHOD

Steel Water Tanks
Filter Beds

For complete details write

RUSTA RESTOR CORPORATION

1440 W. State St., Fremont, O.

FAST WORK ... with new 18-foot lengths of "Century" Pipe laid at rate of 8 feet per minute in Media, Pa.

Media, Pa., recently installed a pressure line, using Keasbey & Mattison "Century" Asbestos-Cement Pipe in the new 18-foot lengths. The time required to lower and couple the first 396 feet was 49½ minutes . . . a speed of exactly 8 feet per minute.

Naturally, installation time varies with the conditions and with the workmen's skill, but the new 18-foot lengths of "Century" Pipe invariably save time and cost. 28% fewer joints are needed . . . 113 fewer joints per mile of line. These new long lengths, which are now furnished in 6" and 8" sizes, class 150, are especially desirable for use on long stretches of line. However K&M 13-foot lengths are available for those cases where trench conditions make shorter lengths of pipe more advantageous. Let our representative recommend the correct length for your requirements.

"Century" Pipe never tuberculates, never corrodes. It has a lastingly smooth interior. It is light in weight for easy, low-cost handling. Its "Century" Flexible Couplings provide tight joints, and permit installing a line in a curve of large radius without using elbows or bends. Write Dept. 1017 for free booklet, "Mains without Maintenance."

Mr. G. D. Houtman, C. E., Member of the Media Council, Chairman of the Water and Sewer Committee, and Assistant County Engineer. Mr. Houtman says, "Our long experience with asbestos-cement pipe has shown us its many advantages. In the new 18-foot lengths, 'Century' Pipe is even more economical."

K&M best in asbestos

KEASBEY & MATTISON COMPANY, AMBLER, PENNSYLVANIA

The fire hydrant for present-day service and traffic conditions

TODAY, fire hydrants must be selected to meet traffic conditions as well as for service demands.

Among the present-day essential fire hydrant requirements must be included strength to resist ordinary impacts, safety for human lives and protection to private property in case of smashing collisions, and economy and speed of repair if accidentally broken.

On the basis of these requirements, the Kennedy SAFETOP Fire Hydrant is rapidly becoming the standard of the country. The Kennedy SAFETOP meets every requirement of strength, safety and economy as well as instant readiness and reliability in service.

It is strong enough to resist any ordinary impact; but if broken by a collision which *no* hydrant could resist, it is speedily and economically returned to service without excavation or shutting off the water supply.

Its easy elbow and nozzle curves and its extra-large standpipe assure minimum pressure loss; and its simple, straight-line operating mechanism assures positive operation without danger of sticking.

Investigate SAFETOP Fire Hydrant protection for *your* community. Complete information sent on request.

The Kennedy Valve Mfg. Co.
Elmira, N. Y.

KENNEDY
SAFETOP FIRE HYDRANT
REG. U.S. PAT. OFF.

(*Continued from page 10*)

New Materials and Gadgets

1. **To record the smoothness** with which an auto, bus or truck is operated, there is a device which, when screwed to the floor, registers the rough starts and sudden stops. It consists of two balls, two inclined tracks and two mechanical counters in a steel case. A quick start or stop rolls a ball far enough up the incline to move a counter.

2. **To keep bugs off windshields,** there has been developed a bug deflector made of transparent plastic. Attached to the radiator guard or grille, it extends several inches above the level of the hood and creates air currents to the top and sides of the car to force the insects away.

3. **A new fire detector** is one attached to the ceiling of a room and, though only 3 in. in outside diameter, is designed to protect an area of 30 ft. by 30 ft. When the temperature in the room rises at a speed equal to, or greater than, 15 degrees per minute, a warning signal is sounded.

4. **No sanding is necessary** for painting or applying a finish to a glossy or enameled surface when using a new product which, when applied with a rag, cleans the surface and sets with a slight tack, permitting the new finish to adhere well.

5. **A baseboard which includes a conduit** for electric or telephone wires is now on the market. Baseboard fronts, of either wood or metal, are snapped to the conduit with strong steel clips so that they can be removed readily without tools to permit installation of additional wires or outlets.

6. **Bill receipting and check writing and signing** can now be done with greater protection and dispatch by a new desk model machine. The operator slides the check or receipt into a chute, indexes the amount on the keyboard and depresses a motor bar, the machine automatically writing the date or consecutive number, safeguarding the amount, accumulating the amount in a locked-in total, and signing the form with an authorized signature.

7. **A new simplified Venturi meter** has been placed on the market. In contrast to orthodox Venturi meters, this meter does not have the piezometer taps in the throat beyond a change in direction of flow but instead has the throat tap in the reducing section itself.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items and citing the August issue as the source.

(*Continued on page 14*)

(*Continued from page 13*)

L. S. Vance, Chief Engineer and Superintendent of the Louisville, Ky., Water Company, will report for active duty in the Army Air Corps about August 15 and will be stationed at Maxwell Field, Montgomery, Ala. B. E. Payne, Principal Assistant Engineer, will carry on during Mr. Vance's service.

Edward S. Hopkins, Filtration Engineer, Bureau of Water Supply, Baltimore, Md., has been promoted from Captain to Major in the Sanitary Reserve Corps of the U. S. Army. When on active duty, Major Hopkins is stationed in the Third Corps Area, Surgeon's Office.

Prof. Lewis H. Kessler has been granted a leave of absence from his position as Acting Chairman of the Dept. of Hydraulic and Sanitary Engineering at the University of Wisconsin. He will spend the year with the Quartermaster General office in Washington, D. C., as head of the Water and Sewer Unit of the Repairs and Utilities Section.

Only one hydrant on a 30-inch main running past the plant was the ultimate explanation of the gutting of the $300,000 establishment of the

(*Continued on page 16*)

CLEAN YOUR WATER MAINS

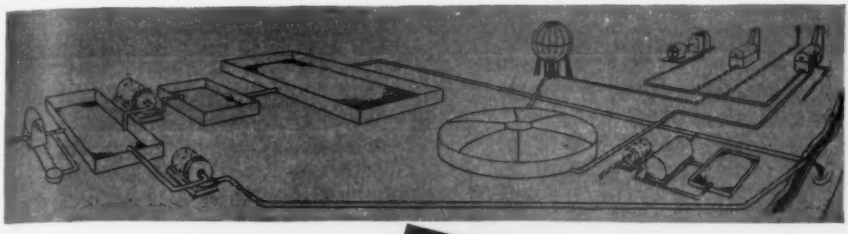
One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

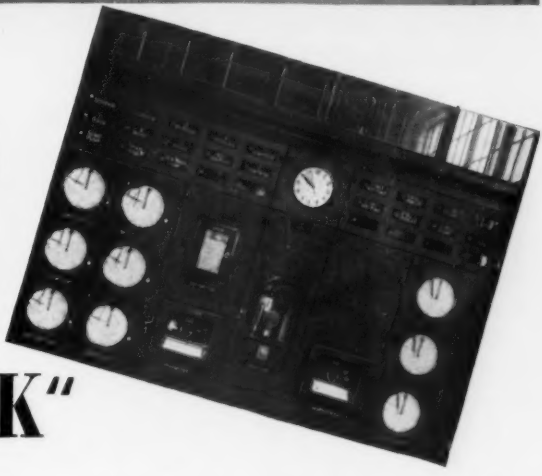
National Water Main Cleaning Co.

30 Church St., New York, N. Y.

BRANCHES

115 Peterboro St., Boston, Mass.
910 William Oliver Bldg., Atlanta, Ga.
7103 Dale Ave., St. Louis, Mo.
406 Florida Theatre Bldg., Jacksonville, Fla.
3812 Castellar St., Omaha, Neb.
205 West Wacker Drive, Chicago, Ill.
501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Canada





BUILD FROM "BEDROCK" in your Public Works Layouts!

Start with Instrumentation by the Originators of Modern Process Control!

Before you lay out water works or sewerage installations, consider the progressive approach to designing which has proved so effective in recent plants. You may project far greater efficiency throughout designs by pre-planning instrumentation as an integral, "working" part of the process, instead of accessory equipment!

Leading engineers are turning more and more to Foxboro for such instrumentation. Foxboro engineers pioneered modern process control for public works and industry . . . originated many "key" instruments, such as flow controllers, recording controllers and throttling controllers with automatic reset. Their experience may furnish constructive suggestions for your projects.

Write for Foxboro Bulletins 232 on sewage plants and 233 on water works. **The Foxboro Company, 150 Neponset Avenue, Foxboro, Massachusetts, U. S. A.** Branches in 25 principal cities.

FOXBORO
REG. U. S. PAT. OFF.
Instrumentation
FOR WATER WORKS AND SEWERAGE SYSTEMS

(*Continued from page 14*)

Wheeling (W. Va.) Machine Products Co.—working on defense orders. Sabotage was first suspected. The one hydrant was within 20 ft. of the building and one of four hoses was required to keep the others from burning. Although the plant site bordered on the Ohio River, no runway had ever been prepared for pumpers to make use of this water supply. Other details concerning this fire are in the National Fire Protection Association's *Quarterly* for July, 1941.

Reeves Newsom, Engineer-Consultant, New York, has been joined by E. H. Aldrich, his principal associate since early in 1938, to form the firm of Newsom and Aldrich.

For over 20 years Mr. Aldrich, a graduate of Beloit and the University of Illinois, has been active in both sewage and water supply work. After serving for five years as City Engineer at Wisconsin Rapids, Wis., he spent two years with Morris Knowles, Inc., of Pittsburgh, as designing and supervising engineer on numerous water, sewerage, sewage disposal, flood control and other hydraulic projects. He was then for three years

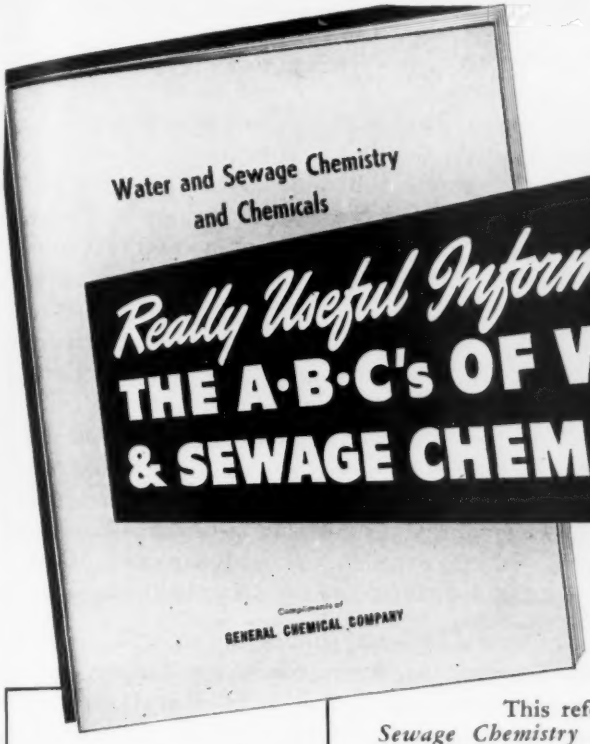
(*Continued on page 18*)

MANUAL OF WATER QUALITY AND TREATMENT

ORDER NOW

The Manual of Water Quality and Treatment culminates many years of intensive investigation and is the absolute authority in its field. Price to members, $2.50; to members for cash with order, $2.25; and to non-members, $3.00. Write for your copy today.

American Water Works Association
22 East 40th Street, New York



Really Useful Information...

THE A·B·C's OF WATER & SEWAGE CHEMISTRY!

Information for Every Operator—
Compiled by
Water and Sewage Authorities

DEALS IN "PLAIN LANGUAGE" WITH THESE SUBJECTS:

- Chemical Terms and Symbols
- How Chemicals Combine
- Chemicals Used in Water and Sewage
- Making Standard Solutions
- Alkalinity and Acidity; Hardness, etc.

This reference book, *Water and Sewage Chemistry and Chemicals,* should find a place in the library of every plant manager, chemist and engineer interested in water or sewage treatment. It is a reprint of material which appeared recently in Public Works Magazine. General Chemical Company is pleased to make the booklet available now to those who may not have had the opportunity to read it.

Photographs, drawings, tables; and clear, concise writing make *Water and Sewage Chemistry and Chemicals* a valuable booklet for layman and technician alike!

To get your copy, fill out coupon below and mail to General Chemical Company.

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Gentlemen: Kindly send me a copy of your new book, "Water and Sewage Chemistry and Chemicals."

Name.....

Affiliated with.....

Address.....

City..... *State*..... :AWW-841

(*Continued from page 16*)

connected in a similar capacity with Nicholas S. Hill, Jr., participating in numerous public utilities valuations.

Mr. Aldrich's next activity was in China as Consulting Engineer for Lingnan University, Canton, in the design and construction of complete works for water supply, electric power and sewerage. For over a year following his return to the United States, Mr. Aldrich was on the staff of the Public Service Commission of New York as engineer in water rate cases.

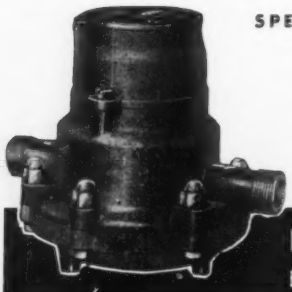
While Mr. Newsom was president of the Community Water Service Company and its forty-three subsidiary companies, Mr. Aldrich served as Chief Civil Engineer. When the Community Company was taken over by another utility company, he was associated with Malcolm Pirnie, Consulting Engineer, New York, for about a year.

In addition to Mr. Aldrich's wide experience in the design and construction of sewerage, sewage disposal and water supply work, he has been associated with Mr. Newsom in original investigational work to determine the mortality survival of water works facilities and the factual bases for depreciation of such works. JOURNAL readers will recall papers by Messrs. Newsom and Aldrich in the October, 1939, and the May, 1940, issues.

A Civilian Defense publication entitled "Protective Construction, Structures Series, Bulletin No. 1" has been prepared by the U. S. War Department with the co-operation of the National Technological Civil Protection Committee and issued by the Division of State and Local Co-operation, Office for Emergency Management. Copies may be secured from the United States Government Printing Office, Washington, D. C., at 25 cents each. The 36-page publication gives detailed information about the most effective methods of protection from the effects of demolition and other types of bombs and includes drawings of a number of types of bomb-proof shelters.

(*Continued on page 20*)

FIRST QUALITY METERS EXCLUSIVELY

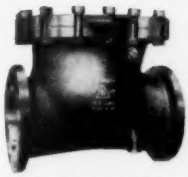


SPECIFY *American* or *Niagara*
(BRONZE CASE) (IRON CASE)
Water Meters
WRITE FOR CATALOG

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.

Prevent Water Contamination..

Eliminate Waste



Uniflow Check Valve

Detector Check with Meter in By-Pass

Grinnell Uniflow Check Valves – used in pairs in public water service pipes to private fire systems – are the sure efficient way to prevent water from a secondary source backing up in public mains and causing contamination. Valves are all bronze, with bronze clappers and moulded rubber facings.

Grinnell Detector Check Valve prevents leaks or misuse of water in fire protection equipment. By-pass and meter accurately measure flows to slightly over 25 gallons per minute. Iron body is bronze mounted with moulded rubber facings.

These valves are made to specifications approved by Factory Mutual Laboratories, and Underwriters' Laboratories, Inc. Write today for Grinnell catalog "Water Works Specialties" giving complete details on fittings, clamps, valves and specialties for Water Works. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island. Branch offices in principal cities.

SOCKET FITTINGS BY

GRINNELL

WHENEVER PIPING IS INVOLVED

(*Continued from page 18*)

Arthur E. Gorman has been placed in charge of the design of the plant and filtering program for the South District in Chicago. John R. Baylis, Physical Chemist, Bureau of Water Engineering, has shifted to the Design Office in the City Hall. Also in the Design Office as Structural Designer is H. E. Hudson, Jr., well known for his service as Secretary-Treasurer of the Illinois Section of the A. W. W. A.

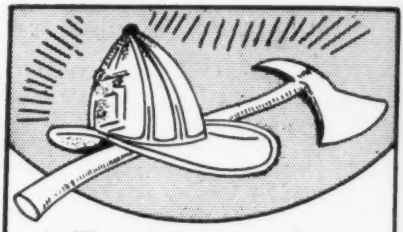
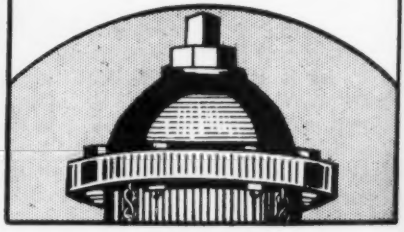
Claude F. Wertz has accepted the position of Resident Consulting Engineer for the Department of Water and Sewers, Miami, Fla. To accept this position, Mr. Wertz terminated his association with Havens and Emerson (formerly Gascoigne and Associates), Consulting Sanitary Engineers of Cleveland and New York.

Working like beavers, five of these animals dammed up Jesse Creek above Salmon, Idaho, and thus stabilized the town's water supply before the local citizens raised funds to build a dam planned by reclamation engineers. Although the beavers, transplanted to Jesse Creek by the Idaho Fish and Game Dept., built the dam 100 ft. away from the planned

(*Continued on page 22*)

FILTER SAND
99 Per Cent Pure Silica
Washed, dried and manufactured to your specifications
Write for Prices on Bulk, Carload or Bags
Dawes Silica Mining Co.
Thomasville, Georgia

AMERICA'S MOST AMAZING PUMP
PEERLESS HI-LIFT
For deep wells 4" or larger
500 to 3500 gallons per hour
ALSO AVAILABLE: TURBINE & PROPELLER TYPES—capacities up to 100,000 g.p.m.
Ask for Literature
PEERLESS PUMP DIV. - Food Machinery Corp.
Factories: Los Angeles, San Jose
Fresno, Calif., Canton, Ohio


A Tradition of the Nations Fire Fighters
KUPFERLE
FIRE HYDRANTS
Specification Sheets on Request
JOHN C. KUPFERLE FOUNDRY CO.
St. Louis


LONG ON PROTECTION

SHORT ON COST

BARRETT ENAMEL

120 ft. lengths of 30" pipe—Chicago Bridge & Iron Co.

MADE FROM COAL-TAR PITCH—the most stable bituminous material known for underground pipe protection—Barrett Waterworks Enamel provides sure protection against external stresses and internal corrosion. These superior enamels are highly dielectric, guard against moisture penetration and resist mechanical distortion. They meet the American Water Works Association's standard specifications 7A.5 and 7A.6 (1940).

Pipe lines protected with Barrett Waterworks Enamel have a long efficient life—at initial capacity. The unusually smooth interior lining maintains a high coefficient of flow. Application of Barrett Waterworks Enamel is *quicker* because of its great fluidity.

Barrett WATERWORKS ENAMEL

Expert Barrett-Trained field men are available on all jobs for which Barrett Enamels are used.

THE BARRETT COMPANY, 40 RECTOR STREET, NEW YORK, N. Y.

(*Continued from page 20*)

site, no objection to this imported labor has been reported and the growing town of Salmon now enjoys its adequate water supply.

Water Supply Police are being developed from 53 rookie policemen drawn from the New York City Police Dept. civil service list. After a two-week course of training for the special service, the police will be assigned to numerous Water Supply Police precincts including one at Ashokan Reservoir.

Defense demands for metal conservation, as well as scarcity of machine tools and skilled labor, have placed a new emphasis—not to say a new value—on the metallizing process which water works men will discover well described in the booklet, "The History, Purpose and Practice of Metallizing," now available upon request to Metallizing Company of America, Inc., 562 West Washington Blvd., Chicago, Ill.

The chief provisions in the Tenure of Office Bill for municipal water and sewage operators in New Jersey, as it went into effect by Governor Edison's signature on June 28, are:

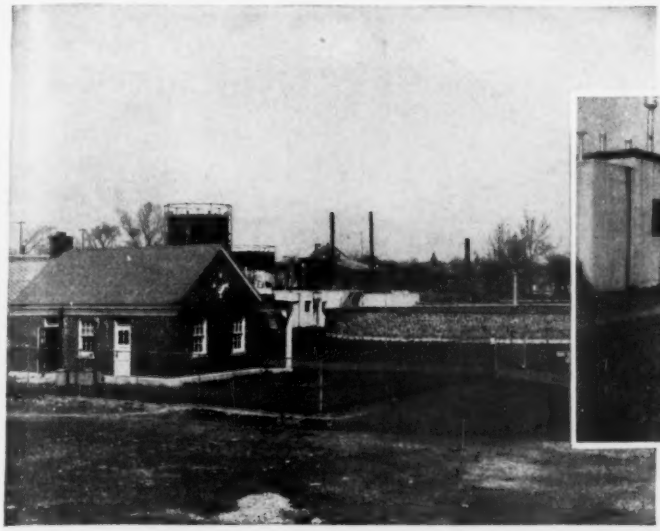
(*Continued on page 26*)

CUMULATIVE INDEX TO THE JOURNAL AND PROCEEDINGS

1881-1939 Inclusive

The Cumulative Index to the Journal and Proceedings of the American Water Works Association is ready for its place on your shelves, where it will render your bound volumes of these publications far more useful for ready reference. After this edition was printed the type was torn down, and future indexes will commence with the issue of January, 1940. Get your copy *now.* Price to members, $1.75; to members for cash with order, $1.50; to non-members, $2.00. Write to—

The American Water Works Association
22 East 40th Street, New York



G. L. Palmer, Superintendent

Stroudsburg, Pa. USES MATHIESON CHLORINE & HTH *for sewage treatment*

"(And)... we are completely satisfied," says Gilbert L. Palmer, Superintendent

● Mathieson Chlorine and HTH have been used in this modern sewage treatment plant at Stroudsburg, Pa. since the plant was first put in operation in 1937. Both products have been used continuously since that time . . . rendering "completely satisfactory" service. Mathieson Chlorine for post-chlorination and HTH in the dosing chamber for the elimination of filter flies—also for regular dosing of the beds.

Satisfactory service is an old story to Mathieson Chlorine and HTH. Stroudsburg is only one of hundreds of cities and towns that find Mathieson sanitation service both dependable and efficient. In Mathieson Chlorine you get *pure* chlorine and prompt delivery in well kept, trouble-free containers. HTH, also, in addition to its use on everyday sanitation jobs, should be kept on hand for quick emergency service requiring a mobile, high-test chlorine carrier.

Write us for full information on Mathieson Chlorine and HTH.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 100-lb. drums.

THE Mathieson Alkali Works (INC)
60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

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Consulting Engineers for Water Supply, Water Purification, Sewerage, Disposal of Sewage, and Municipal and Factory Wastes, Operation of Purification Plants and Sanitary Analysis.
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Help Build up Your Association by Bringing in a New Member

SEND FOR APPLICATION BLANK

AMERICAN WATER WORKS ASSOCIATION
22 East 40th St.
NEW YORK CITY

(*Continued from page 22*)

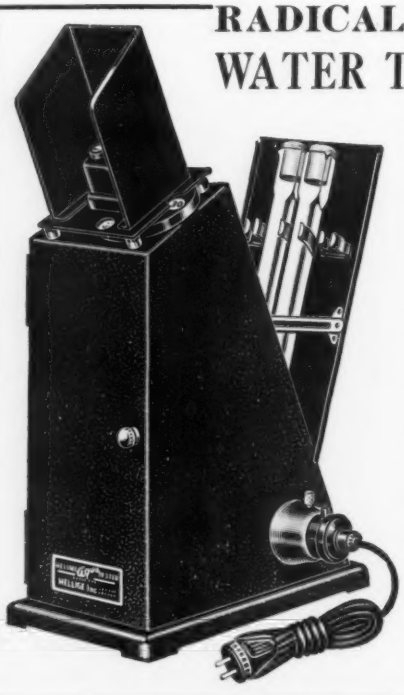
[No person licensed as] "having direct general charge of the operation and maintenance of public water systems or sewage disposal or treatment plants after five year's consecutive service in any such position shall be removed from his position or subjected to a reduction of salary except for good cause and after a public hearing.

"In computing such five years' service, the time served before the passage of this act shall be included, as well as time served after the passage hereof.

"The public board, officer or commission having power of appointment of any such person whom it is sought to remove or whose salary it is sought to reduce, shall formulate or receive charges, in writing, against such person and shall fix a time and a place for a hearing thereon. A written copy of the charges and a written notice of the time and place of the hearing shall be served upon the person sought to be removed at least five days prior to the hearing.

"At the hearing, the public board, officer or commission shall hear all witnesses and receive all evidence produced and if the charges are found to be true in fact and just cause be shown, the public board, officer or com-

(*Continued on page 28*)



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The new Hellige Aqua Tester combines the thoroughly demonstrated advantages of Hellige *non-fading glass color standards* with radical improvements in design. This new model is, we believe, the most advanced type ever brought on the market and demands special consideration as it brings to its user the utmost in permanent reliability, accuracy, convenience and, last but not least, economy. Standards for all popular A. P. H. A. and A. W. W. A. Methods and Hydrogen Ion Control are available.

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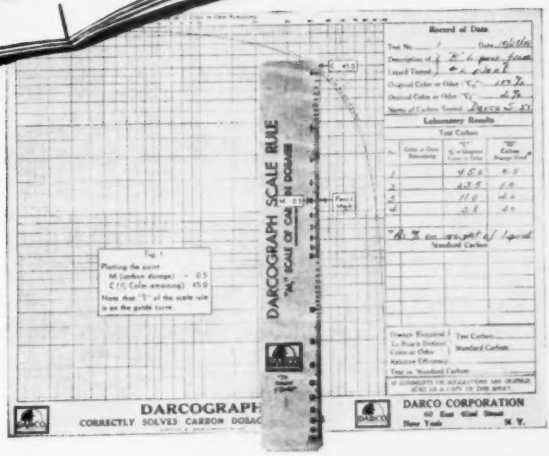

Check PERFORMANCE for yourself!

FORGET CLAIMS—get the facts on activated carbon! Use the Threshold Odor Test, the Carbon Feed Chart, and the Darcograph to check carbon performance right in your own plant!

See for yourself that Hydrodarco—the activated carbon specially made for water treatment—brings maximum palatability control per dollar.

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The Darcograph—one of the 3 performance tests evolved by Darco for waterworks men.

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The new-style bag is sealed and taped with Latex tape, to prevent sifting.

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LOS ANGELES
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(*Continued from page 26*)

mission may remove or reduce the salary of the person against whom charges are made.

"The purpose of this act is to prevent the unwarranted removal or reduction of salary without just cause of the individual who is now or shall hereafter be directly responsible for and in direct charge of the maintenance and operation of public water systems and sewage disposal or treatment plants. This act shall not, however, affect any public officer whose term of office is now or shall hereafter be fixed by statute.

"This act shall not apply to private corporations engaged in selling water to the public, either at wholesale or retail or to private corporations owning and operating public sewage disposal or treatment plants."

Los Angeles' Mono Basin project is about completed, only Long Valley Dam needing finishing touches. Thus mountain water will be intercepted before it is emptied into saline Mono Lake, the series of diversion works conveying it in its native purity to the Owens River, thence to Los Angeles. The project includes many miles of intercepting conduit, Grant Lake Dam and Reservoir, Mono Craters Tunnel and Long Valley Dam.

(*Continued on page 30*)

Manual of Design for Cast Iron Pipe—A21.1

Specifications for Pit Cast Cast Iron Pipe—A21.2

Specifications for Cement Mortar Linings for Cast Iron Pipe—A21.4

It is imperative that every water works operator in charge of purchasing have at hand and follow this manual and these specifications. They are sponsored by the American Gas Association, the American Society for Testing Materials, the American Water Works Association, and the New England Water Works Association, jointly, and are recognized by both operators and manufacturers as the final authority. Order yours today.—A21.1, $.40; A21.2, $.20; A21.4, $.15. Published by

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NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.

For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

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• • • AN AUTHORITATIVE WORK CONCERNING THE CONTROL OF MICRO-ORGANISMS AND ELIMINATION OF TASTES AND ODORS

This revised and enlarged edition, written by Dr. Frank E. Hale, describes in complete detail methods of control of the various forms of microscopic life commonly dealt with in water supply systems. Descriptive material includes 48 beautifully clear photomicrograph studies of the organisms discussed. Simplified methods of applying copper sulphate are also well diagramed and fully illustrated by photographs.

Thousands of copies of this 44 page book have already been distributed throughout the world. *Plant engineers and others concerned with this subject should not be without* "THE USE OF COPPER SULPHATE IN CONTROL OF MICROSCOPIC ORGANISMS." Write for it today on your business letterhead.*

* Unfortunately, because of the cost of preparation of this book, it is necessary to limit its distribution to those who are professionally occupied with this subject.

† Director of Laboratories, Dept. of Water Supply, Gas and Electricity, N. Y. C.

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99% + PURE

Made by
PHELPS DODGE REFINING CORPORATION
Refiners of Electrolytic Copper
Offices: 40 Wall Street, New York, N. Y.
230 North Michigan Avenue, Chicago, Ill.

(*Continued from page 28*)

Mono Craters Tunnel was built through 11 mi. of extinct volcanoes, where terrific earth pressures, vast quantities of carbon dioxide gas and great forces of underground water required courageous and often times unique engineering. The Long Valley Dam is being built in the Owens River streambed and will form a huge storage and regulating basin of a capacity of 163,000 acre-ft.—more than all the previous storage facilities of the municipal system.

At the suggestion of H. A. Van Norman, Chief Engineer and General Manager of the Water Bureau, the Board of Water Commissioners has officially named the body of water created by the Long Valley Dam, Lake Crowley in honor of the renowned "padre of the desert," the late Rt. Rev. John J. Crowley, whose services in behalf of the people in Inyo and Mono Counties and of Los Angeles earned for him their lasting respect and esteem.

The LaMotte Chemical Products Company, of Towson, Baltimore, Md., has just announced a new outfit for determining total sulfides, dissolved sulfides and hydrogen sulfide in sludge, air and gases. This outfit is known as the LaMotte-Pomeroy Sulfide Testing Set.

The methods employed in this outfit were developed by Dr. Richard Pomeroy and with his exclusive co-operation, the apparatus was developed in the LaMotte Research Laboratory. The outfit is complete in every detail, including sampling pipettes, test tubes, solutions, flocculating bottle and set of instructions in handy wooden carrying case.

A prize contest open to water works superintendents and engineers has been announced by Pennsylvania Salt Manufacturing Company, Philadelphia, Pa.

The purpose of this contest is to obtain interesting case histories of emergency water purification with Perchloron, the high test calcium hypochlorite made by Pennsylvania Salt Mfg. Co. Such case histories may deal with unusual conditions where normal chlorination has been rendered

(*Continued on page 32*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

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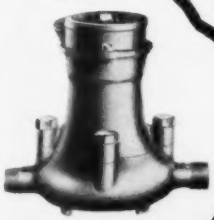

Water Meters Keep Down Pumping Costs

METERING PROGRAM COMPLETED

What Water Meters Do

Greatly reduce water waste

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Keep down pumping costs

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Conserve water reserves

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Distribute water costs fairly

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Reduce water rates

OFTEN—too often—in many communities, the question of installing new pumps and larger water mains has loomed unpleasantly before a dollar-conscious Water Board. Increased water consumption made the expense seem all too inevitable . . . until water meters were put on the job to check up on water wastes . . . then pumping costs took a downward turn! The result (judging by actual experience in a number of cities) was that buying new pumps, or laying larger mains, or increasing storage capacity has often been postponed for years . . . and there have been many notable reductions in sewerage expenses too, because the less water used, the less water was passed through sewers . . . thanks to the watchfulness of water meters.

Trident Meters

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Neptune Meters, Ltd., 345 Sorauren Avenue, Toronto, Canada.

4

• *One of a series of advertisements outlining the five ways in which Water Meters increase operating efficiency, reduce costs and add to the revenue of the modern Water Works.*

(Continued from page 30)

impractical because of flood or fire, pollution entering a water main at some inaccessible or not easily traceable point, accidental rupturing of mains, etc.

Prizes of twenty-five dollars ($25.00) will be awarded for the most outstanding of such case histories. Authors of other reports deemed worthy of recognition but not meriting major prizes will receive prizes of five dollars ($5.00) each. Entries in this contest are limited to a length of 500 words or less. The closing date for entries is October 1, 1941. Water works superintendents and engineers wishing to enter the contest should send their case histories as soon as possible to Pennsylvania Salt Mfg. Co., 1000 Windener Building, Philadelphia, Pa.

A comprehensive treatise on every phase of swimming-pool sanitation has just been published by the Mathieson Alkali Works, Inc., 60 East 42nd Street, New York City.

This 50-page book, entitled "Keeping the Pool Safe and Sanitary," discusses all modern methods of purifying the water of every type of swimming pool, from the small private pool to large nautral bodies of water. It also gives directions for algae control, prevention of the spread

(Continued on page 34)

Economies in Office Forms
By Israel Rafkind

Recommended Practice for Distribution System Records

Committee Report

Coordinating Operating System Records With Accounting Records
By Nathan B. Jacobs

UNDER ONE COVER

These three documents, reprinted from the February, 1940, issue of the JOURNAL, constitute a basis upon which the head of any water department, whether it be large or small, may build an economical and practical system of keeping distribution records. The system recommended is wholly adequate, yet in no way burdensome. These outlines are compiled by authorities and should be in your hands today.—64 pp., $.25.

American Water Works Association
22 East 40th Street, New York

Another Reason for Rensselaer Quality

A transverse and deflection test of a Cast Iron Bar on a Riehle Testing Machine.

Tests are made daily of all Iron and Bronze used in Rensselaer Valves, Hydrants and other Products, to maintain QUALITY of the highest standards.

Buy RENSSELAER for QUALITY

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TROY, N. Y.

(*Continued from page 32*)

of athlete's foot and other infectious diseases, control of pool-water alkalinity, the care of sand beaches, and other details of pool and locker-room sanitation. Methods of testing the pool water for residual chlorine and for pH, or alkalinity, are fully described.

This informative book will be of interest to the operator of every public, institutional, club, and private swimming pool and also to camp directors. Copies can be obtained free on request to the publisher.

Niagara Alkali Company and Electro Bleaching Gas Company, two firms well known throughout the chemical world, have joined forces and on July 1 began operations as one organization under the name of Niagara Alkali Company. Niagara has pioneered in the production of caustic potash in America and has recently become the first American producer of carbonate of potash, used chiefly in the manufacture of fine glassware. Electro Bleaching Gas has pioneered in the production of liquid chlorine in America and in introducing its use in the textile, pulp and paper, and the shellac industries as well as in the fields of water and sewage sterilization.

(*Continued on page 36*)

WATER REFINING EQUIPMENT HEADQUARTERS
INDUSTRIAL—PROCESS
RAILROAD—MUNICIPAL—HOUSEHOLD

FILTERS Of All Types *and* Capacities . . . Gravity . . . Pressure
SOFTENING SYSTEMS
All Types *and* Capacities—Zeolites (*synthetic and natural*) and Lime and Soda
CHEMICAL FEEDERS (wet or dry)
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EQUIPMENT FOR REMOVAL
Of Iron . . . Taste . . . Odors . . . Colors . . . Suspended Matter
SWIMMING POOL EQUIPMENT
AERATORS · DE-GASIFIERS
WATER TEST SETS
RE-CARBONATORS

The **AMERICAN WATER SOFTENER COMPANY**
WATER REFINING EQUIPMENT HEADQUARTERS
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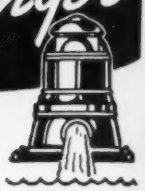
HOUSEHOLD, ETC.
Lehigh Ave. & 4th St., Phila., Pa.

Built to Serve Longer



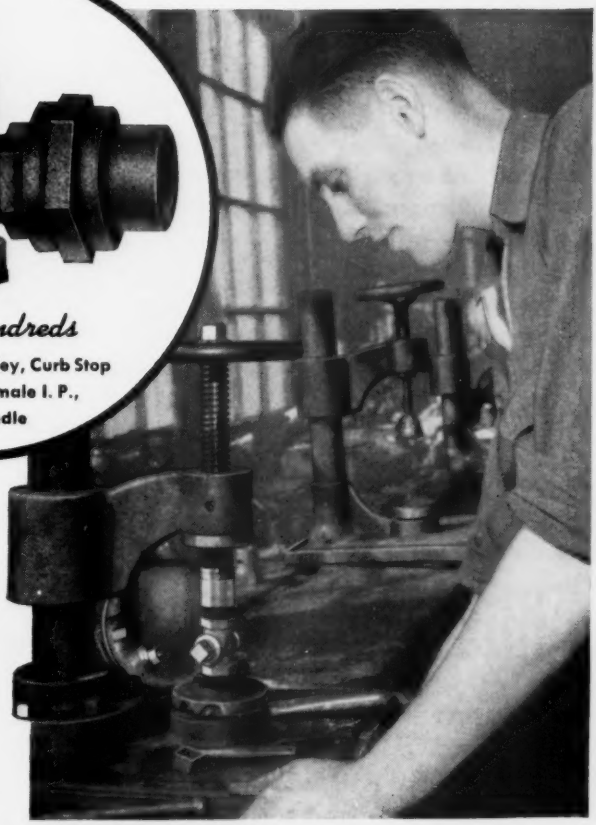
Every part of a Layne Well Water System will stand the heaviest duty; the hardest grind and longest non-stop runs. They are built to stand up—and give you far more than might be expected. Dollar for dollar they will pay greater dividends. Write for Catalogs, Folders and Bulletins. No obligation. LAYNE & BOWLER, INC., Memphis, Tenn.

LAYNE WELLS & PUMPS

GOOD—FOR 200 LBS. PRESSURE

One of Hundreds

Fig 88A—Inverted Key, Curb Stop Lead Flange X Female I. P., Brass T Handle



1. Hays builds a one-quality water works brass line from (85-5-5-5 Mix).
2. Hays tests every piece at 200 lbs. hydrostatic or more.
3. Hays Brass features full water-way.
4. Hays individually ground-in plugs are specially lubricated for easy turning.
5. Water Works Standard Threading permits use of Hays Brass in any standard tapping machine.
6. Hays builds a complete line.

OR GOOD FOR SCRAP

EVERY piece of Hays Water Works Brass is tested at 200 lbs. Hydrostatic or more, to assure water-tight pieces getting into your services. This 100% test is important to Hays too, for it serves as a constant check on foundry technique, saves us time and materials, helps to improve our product. You can depend on Hays Brass; that is why every piece carries the Hays trade mark, symbol and identification of a quality product. Write for Catalog No. 5 and further data.

COPPER • BRASS • LEAD • IRON

HAYS *Water Works* PRODUCTS

HAYS MFG. CO., ERIE, PA. • *Since 1869*

(*Continued from page 34*)

J. Clarke Cassidy, for many years Works Manager of the Niagara Alkali Company and Electro Bleaching Gas Company, has been elected President of the Niagara Alkali Company, and E. D. Kingsley has been elected Chairman of the Board. S. W. Jacobs and S. J. White continue as Vice-Presidents.

The Thompson Electric Co., 1101 Power Ave., Cleveland, Ohio, recently issued Catalog No. 41 (40 pp.) describing: disconnecting and lowering hangers, shock absorbers, suspension devices and accessories, special appliances, chain, chain and cable fittings and wire cable for lighting fixtures.

Greene, Tweed & Co., manufacturer of Palmetto and other brands of packing and special tools, has moved its manufacturing plants and general offices to the Palmetto Bldg., Bronx Blvd. and 238th St., New York, N. Y. This large modern plant will provide additional facilities for the 78-year old firm which has grown steadily after pioneering in the manufacture of self-lubricated packings.

(*Continued on page 38*)

BUILDERS *Flow Nozzle*—Insert Type

A METER*

FOR THAT SMALL PIPE LINE!

- A new type of nozzle.
- Easily installed between flanges.
- Recovery cone conserves head.
- Low loss cuts pumping costs.
- Use with standard instructions.

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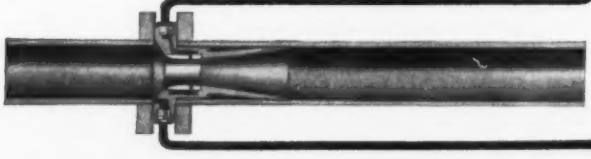
(DIVISION OF BUILDERS IRON FOUNDRY)

Providence **Rhode Island**



* *Ask for Bulletin* 319.

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A large stock constantly on hand,
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Special Castings

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Works
PHILLIPSBURG, N. J.
EVERETT, MASS.

(*Continued from page 36*)

The appointment of Dr. C. F. Rassweiler as Director of Research of Johns-Manville Corp. has been announced by Lewis H. Brown, President of Johns-Manville. Dr. Rassweiler has been Director of the Philadelphia Laboratory of E. I. duPont de Nemours Co.

The meter business of Builders Iron Foundry, Inc., is now conducted under the new name of Builders-Providence, Inc. Directors and officers remain the same under the new name. Builders is one of the country's oldest industrial organizations, having been started in 1820 to supply cast-iron columns and miscellaneous hardware. A machine shop was added several years before the Civil War. Soon after the invention of the Venturi Tube by Clemens Herschel in 1887, Builders acquired exclusive manufacturing rights and laid the foundation for the Venturi Meter. The concern now offers a long list of precision instruments for metering and controlling liquids in many ways.

Peerless Pump Company, 301 W. Ave. 26, Los Angeles, Calif., has recently issued Bulletin No. 148 describing its new Peerless Hydro-Foil pumps developed by the application of aerodynamic data in the field of hydraulics.

(*Continued on page 40*)

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M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.

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Do you have back issues of the Journal which you will make available to the Association to help replenish its stock? Send a post card telling which you have of the numbers listed below and 50¢ will be paid for each copy obtained.

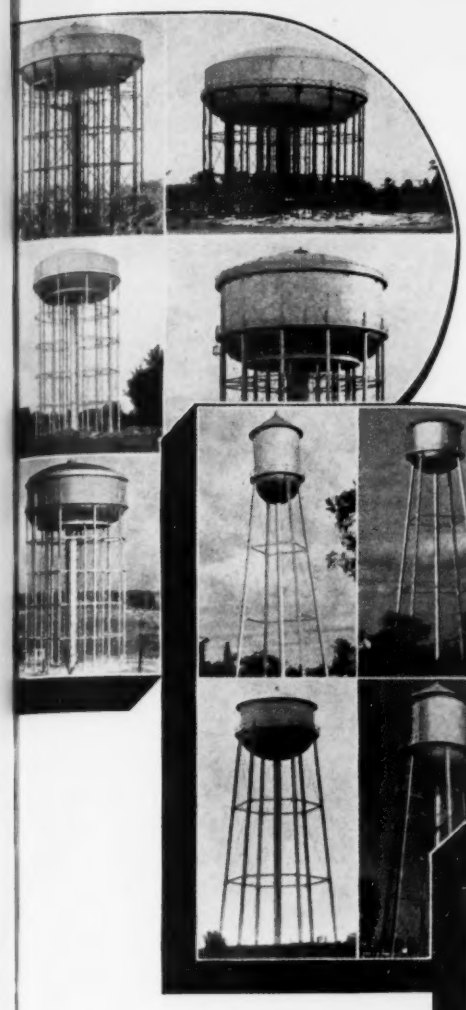
1924—September

1926—January, February, April, May, June, September, November

1929—January

1930—January

American Water Works Association
22 East 40th St., New York



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(*Continued from page 38*)

Report of the Southeastern Section Meeting

The thirteenth annual meeting of the Section was held in Charleston, S. C., May 12–14, 1941, at the Fort Sumter Hotel, with an official registration of 192. The following National Officers attended this meeting: President Norman J. Howard, Treasurer W. W. Brush and Secretary Harry E. Jordan. President Howard, who attended the Pacific Northwest Sectional Meeting in Seattle, Wash. on May 8–10, flew from there to Charleston to attend this meeting.

May 12 was devoted to papers and the business meeting. The morning session was opened by a paper on the Santee-Cooper Dam by L. F. Harza, President of the Harza Engineering Co. The remainder of the morning was devoted to a session on elevated tank and standpipe maintenance with the following authors scheduled: H. F. Stearns, Chicago Bridge & Iron Co.; John Perryman, R. D. Cole Co.; and C. D. Turner, Wailes Dove-Hermiston Corp. The subject was freely discussed from the floor, the main point brought out being that careful study should be made of the vehicle and not so much the pigment in any paint. Also, there was considerable discussion of cathodic protection for tank maintenance.

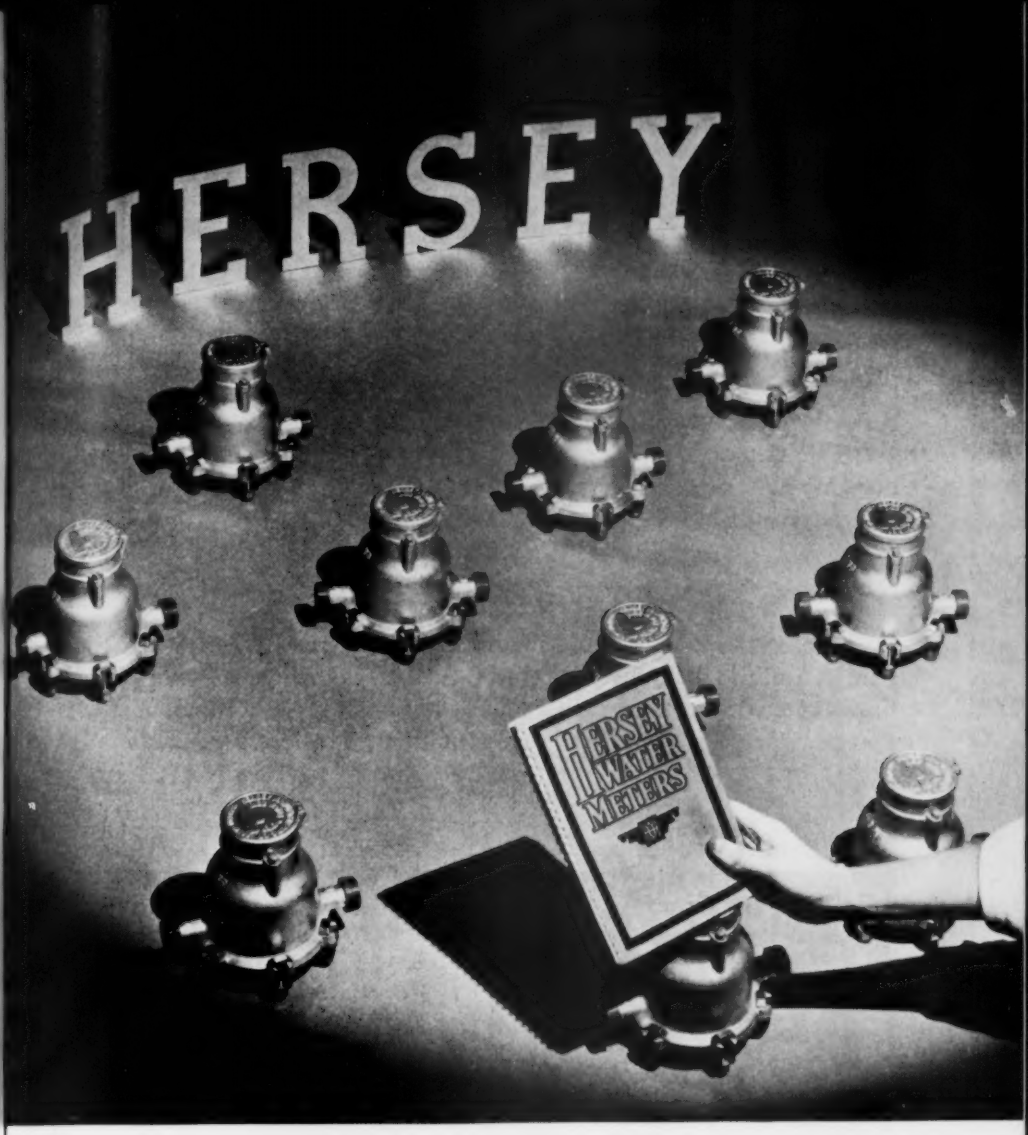
In the afternoon session on well water treatment the following were scheduled: H. M. Mathews, Thomasville, Ga.; M. G. Stewart, Natchez, Miss.; and F. K. Ellis, Sumter, S. C. The use of "Calgon" for stabilization of iron in well water was discussed by Mr. Ellis, Superintendent, Sumter, S. C., who said he had been using "Calgon" for nearly a year in water from one of the wells at Sumter which has about 3 p.p.m. iron, and 50 p.p.m. carbon dioxide.

Tuesday an inspection trip of the water supply of Charleston was made. During this trip the 22-mile unlined tunnel through Marl, which was constructed by the Charleston Water Dept., was inspected. This tunnel delivers 50 m.g.d. raw water from Edisto River to the Goose Creek pumping station. About 30 m.g.d. is pumped to the Paper Plant of the West Virginia Pulp & Paper Company, which is located about 2 miles from the Goose Creek pumping station. During this trip, pipe with various types of lining, which has been handling a very corrosive water for about three years, and which had been removed from service, was inspected.

Wednesday an inspection was made of the Santee-Cooper Hydro-Electric project, which is the largest of its kind ever to be built in the coastal section of the South. After this inspection, the meeting adjourned.

At the business meeting on Monday afternoon, the following officers were elected: M. G. Stewart, of Natchez, Miss., Chairman; Frank G. Crow, Florence, Ala., Vice-Chairman; W. W. Pointer, Troy, Ala., Trustee for Alabama; J. T. Pinkston, Meridian, Miss., Trustee for Mississippi.

(*Continued on page 42*)



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(*Continued from page 40*)

Mr. J. E. Gibson, Manager and Engineer, Charleston Water Department, was selected for the George W. Fuller award.

The entertainment consisted of a "Get-To-Gether" meeting on Monday night in the ballroom of the Fort Sumter Hotel, at which refreshments were served and enjoyed by all. Tuesday night the annual banquet was held in the ballroom of the Fort Sumter Hotel, with the principal speaker being General C. P. Summerall, President of the Citadel, who spoke on the past and present war in Europe and preparedness.

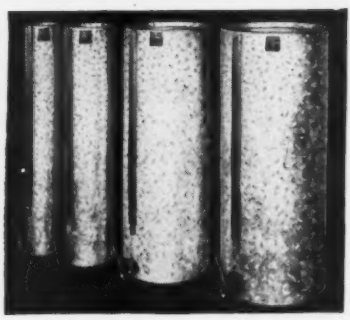
The Membership Committee under the able leadership of its Chairman, W. L. Avrett, Jr., secured eleven applicants for membership during the convention.

B. P. RICE
Secretary-Treasurer

Those interested in publications of the National Association of Railroad & Utilities Commissioners are asked to note that the official publishers of certain publications announce the following stocks: *Depreciation Principles and Methods*, 435 copies; *Uniform System of Accounts for:*

(*Continued on page 44*)

Ford Calibrated
TESTING TANKS



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Cathodic Protection ends rust
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Cleans old tanks
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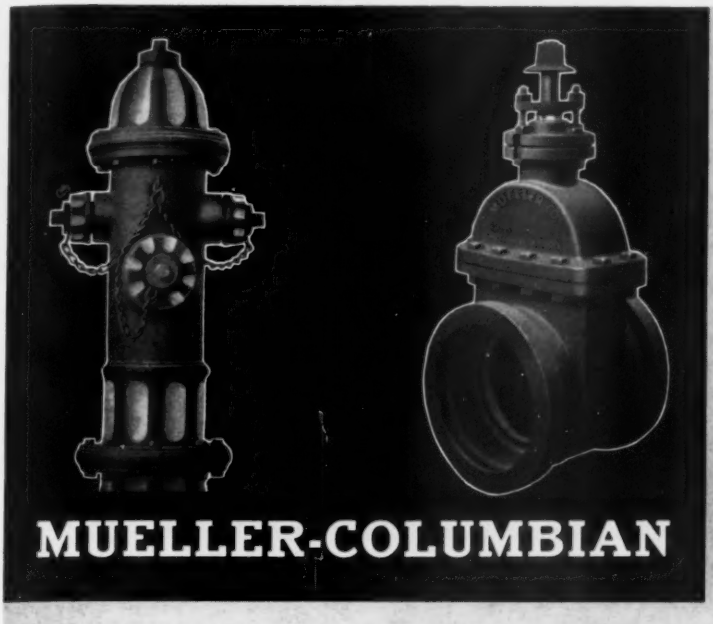

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Mueller-Columbian Fire Hydrants have many exclusive features including the SELF-OILING TOP, the SAFETY-FLANGE SECTION and the ingenious MAIN VALVE ASSEMBLY. These are some of the reasons they are known as the low-cost maintenance hydrants.

Mueller-Columbian Gate Valves are the only valves that use the FOUR-POINT wedging principle by which the pressure is applied at 4 POINTS near the edges of the valve discs. This guards against sprung discs and insures a leak-proof valve.

MUELLER CO. CHATTANOOGA, TENN.

(*Continued from page 42*)

Electric, or *Gas*, or *Water Utilities*, 375 copies of each; and *Effect of Court Decisions Upon State Jurisdiction Respecting Depreciation*, 75 copies. The official publisher is The State Law Reporting Co., 30 Vesey St., New York, N. Y.

"Principles of Sewage Treatment" by Dr. Willem Rudolfs, Chief, Dept. of Water and Sewage Research, Rutgers University, has just been issued by the National Lime Assn., 927 15th St., N.W., Washington, D. C. The publishers state that the booklet is not planned to serve as a complete text, but rather is it designed to be a helpful reference for those interested in learning more about the role played by biological agencies in sewage purification and the factors which affect the activities of organisms. Also included are a brief on microbiology and chapters devoted to operation and control, which may prove very useful to small plant operators.

Literature and various published data on regional water supply control and development have been made available by the Interstate Commission on the Delaware River Basin, Broad Street Station Building, Philadel-

(*Continued on page 46*)

STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere

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A DEPENDABLE SELF - CAULKING JOINT COMPOUND

no change in coefficient in 8 years

It was news 6 years ago that spun Bitumastic Enamel lining in water pipe had the highest flow coefficient of any material.* It is even bigger news now to learn that this high coefficient has been unimpaired after 8 years of service.

This occurred in the case of the 10 miles of 30" steel water pipe of The Panther Valley Water Company, Lansford, Pa., spun lined with Bitumastic Enamel in 1932.

When the line was installed, the flow test showed Williams & Hazen coefficients up to 145.8. The second test, run on November 17, 1940, after 8 years of service, showed coefficients from 145.5 to 151.

As the spun lining application is superior in thickness of coating and smoothness of surface to the old hand brushed method it is reasonable to expect that its performance will ultimately surpass even the enviable records of the latter—which to date have given protection against corrosion for 25 years and more without signs of disintegration.

*Committee on Pipe Line Coefficients of New England Water Works Assoc. (N. E. W. W. A. Journal, Sept. 1935)

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AQUA PURA? *Look again!*

"Natural" water *needs* conditioning . . . and now every city can have it!

New developments by Permutit* now put the benefits of soft water within reach of every community. Modern equipment—like Permutit's Spaulding Precipitator—takes less space, makes bigger savings.

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Features: 1—Sludge is kept suspended, speeding precipitation and acting as a contact filter; 2—Conical filter chamber lowers velocity of rising water, keeps sludge uniformly dense for filtering.

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WATER CONDITIONING HEADQUARTERS

COOK Well Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

A. D. COOK, INC.
Lawrenceburg - Indiana

COOK Deep-Well Turbine Pumps

(*Continued from page 44*)

phia, Pa. A catalog, "Incodel Maps, Charts, Graphs," lists all the material in the collection maintained at the Administration Offices at the above address where it is available for reference use by public or private agencies.

V. P. Rumely has been elected Vice-President in Charge of Manufacturing of the Crane Company, succeeding J. H. Collier who in May was made President. Mr. Rumely has been Works Manager of the Crane Chicago plant for the past four years.

The Fifteenth Annual Conference of the Pennsylvania Sewage Works Association has been postponed from June of this year to the dates of September 3, 4, and 5, 1941, at State College, Pa.

The Engineering Society of Western Pennsylvania will hold its Second Annual Water Conference in the Urban Room of the William Penn Hotel on November 3 and 4, 1941. These dates have been changed from dates in October previously announced.

The first Hydrology Conference at State College, Pa., held under the joint auspices of the Section of Hydrology of the American Geophysical Union, the Civil Engineering Division of the Society for the Promotion of Engineering Education, the Committee on Hydrology of the American Society of Civil Engineers, and The Pennsylvania State College, drew an

(*Continued on page 48*)

Use LaMotte Equipment for
pH Control—Residual Chlorine Control
Boiler Feed Water Control
Determination of sulfides in
sludges and gases

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"Originators of the practical application of pH Control"
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Their dependability of performance is traditional... is it any wonder that these fine products are ***BEING ENTHUSIASTICALLY RECEIVED*** by the waterworks profession . . . ***EVERYWHERE ?***

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May we remind you again that we are exclusive agents for the Tate Pipe Lining Process . . . the rejuvenation treatment which will restore, preserve and even increase the carrying capacities of your pipe lines for years to come.

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(*Continued from page 46*)

attendance of more than 230 persons. Fifty hydraulic engineers and hydrologists representing government agencies, corporate and private enterprise took part in the scheduled program.

Five major symposia outlined the fields under the headings: the scope of applied hydrology; rainfall and runoff; delays in the hydrologic cycle; losses in the hydrologic cycle; and flood problems. The convention closed with a group of informal round-table discussions.

(*Continued from page viii*)

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QUEBEC PUBLIC SERVICE BOARD. Gustave St. Jacques, Court House, Quebec, Que., Canada
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DEVORE, E. J. Supt. Boro Water Works, 403 Center St., Cambridge Springs, Pa.

Reinstatements—Active Members

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ANGELL, J. M., JR. Eastern Mgr., *Water Works & Sewerage*, 155 E. 44th St., New York, N. Y.
ARNOLD, ROY. Water Supt., Whitefish, Mont.
BENJAMIN, ROSELLE G. Supt., Riverhead Water Dist., 220 Roanoke Ave., Riverhead, N. Y.
BENSON, RALPH L. Dist. Engr., Union Ice Co., 660 S. Alameda St., Los Angeles Calif.
CLARK, ARTHUR T. Secy.-Mgr., Water & Sewage Works Manufacturers Assn., 22 East 40th St., New York, N. Y.
FITZGERALD, HOWARD W. Chief Engr., Div. of Water, Buffalo, N. Y.
GROTZ, WILLIAM H. Asst. Engr.-Construction, Div. of Water, Porter Ave. Pumping Station, Buffalo, N. Y.
HETZER, HUGH W. Engr., West Virginia Water Service Co., 181 Summers St., Charleston, W. Va.
KELSEY, REGINALD A. Patrolman-In-Charge, Water Dept. of Los Angeles, Box 406, Mojave, Calif.
LORD, CHARLES H. City Engr., 110 Crescent Place, Ogdensburg, N. Y.
RUTLEDGE, E. A. Vice-Pres., Rensselaer Valve Co., Troy, N. Y.
TREMBLAY, J. A. Water Works Engr., 98 Bougainville Ave., Quebec, Que., Canada
WAGNER, HENRY F. Chief Chemist, Div. of Water, Buffalo, N. Y.

(*Continued on page 50*)

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PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

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on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

Why not use it in your plant and benefit thereby?

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News of the Field

More about priority—this time to consider whether public water supply services should be given automatic priority to cover all their needs.

Let's do some thinking—

The system of priorities was established in the Office of Emergency Management in order to insure primary consideration of the nation's needs for defense materials. This discussion is not intended to dispute the validity of such an idea. It assumes such validity. If space permitted, one might point out that national unity and defense of our national ideals appear to be the two most important things to which Americans should give their support and lend their energies. Considering that defense materials are of utmost importance to every citizen, then all of us should be prepared to do without some things it if is a choice of defense or "us."

Think of the magnitude of the defense program. Eighteen billion dollars worth of defense production is scheduled for 1941. That equals the total dollar value of all manufactured products in the U. S. in 1929. Think then for a moment and it must be realized that the 18 billion dollars worth of defense materials cannot be produced alongside even a 10 billion dollar industrial production without dislocating something. That something must be civilian—not defense.

The defense program has not *yet* used up the entire amount of any one material that is to be had in the U. S. There is even a little aluminum left after defense needs are met—but for every ton that there is, normal civilian use would consume 15 tons. So a system of priorities has been set up for critical civilian services and if the material needed is to be used to repair an existing unit, the order for it can be rated as high as some defense materials. If the need is for extension material and the relation that the extension bears to a supply of water for a defense industry can be proven, that material will be given a rating in the defense category.

But many water works men are not satisfied. They feel that public water supply is so important to all defense activities and to public health and morale that a standing equal to direct defense should be given to every need of public water supply.

Let's stop for a minute! What is a priority system intended to be? It is a means of giving full preference to things that are most important in the direct defense program and giving limited preference to things that are of prime civilian importance and contributory to defense.

(*Continued on page 2*)

(*Continued from page 1*)

Now if every industry and service that considered its work "contributory to defense" received the preference some of its workers have requested on its behalf, everything would be on an A-1-A preference basis and we would be back where everything started.

But some readers may inquire, why should the JOURNAL of the American Water Works Association even imply that public water supply is not in a class by itself as a civilian activity and the one most essential to defense. The answer is that its Editor has studied the preferred civilian list set up by the O.P.M. and agrees that railroads, electricity supply, gas supply, metallurgical plants, coke converters and urban transportation services bear *as of this date* just about as important a relationship—to defense as a whole—as does public water supply. It is also noted that for the present at least, chemical manufacturing plants, food processing plants and hospitals are not rated so essential as public water supply.

Will any reader who has patiently followed to this point, if he be a water works man, detach himself from his work for a moment and put on the

(*Continued on page 4*)

Eduardo J. Chibas, well known Cuban engineer, died on August 21 at the age of 72 at his home in Vedado, a suburb of Havana. He was well known in the United States, having come here as recently as a year ago to receive the honorary degree of Doctor of Engineering at Rensselaer Polytechnic Institute, from which he had been graduated in engineering in 1889.

Dr. Chibas was born in Santiago de Cuba and was educated in Cuba before going to Rensselaer Polytechnic Institute. During the Spanish-American War he served as an engineer with the United States Fifth Army Corps. He was in the United States for many years as an exile from Cuba after his imprisonment for his alleged part in an attempt to overthrow the government of President Gerardo Machado. In 1933 he returned to Cuba to accept the post of Secretary of Public Works in the Cabinet of President de Cespedes.

Dr. Chibas was an Active Member of the A. W. W. A. and had served as Chairman of the Cuban Section. He was President of the Cuban Society of Engineers and a life member of the American Society of Civil Engineers. A part of the citation read at Rensselaer Polytechnic Institute's commencement exercises last year cited his "loyal and helpful co-operation in bringing the peoples of North America and Latin America into closer relationship." Dr. Chibas is survived by a widow and two sons, Raul and Eduardo, Jr., a student leader during the revolutionary period who is now a member of the House of Representatives.

WHERE TUBERCULATING WATERS MUST BE TRANSPORTED

(LESS THAN 25% OF THE U. S. A.)

USE LINED CAST IRON PIPE*

THE areas of the United States where tuberculating waters materially affect the carrying capacity of pipe represent *less than one-quarter of the total area of the country.* If you are located within one of these areas, use *lined* cast iron pipe. You do *not* have to sacrifice the long life, low maintenance cost and salvage value of cast iron pipe in order to be assured of high carrying capacity throughout the life of the pipe you buy. The Cast Iron Pipe Research Association recommends *lined* cast iron pipe where tuberculating waters must be transported. Lined cast iron pipe is the only pipe that will have 100 years of useful life plus 100 years of high carrying capacity. Send for map which shows approximately 76% of the country where little or no tuberculation is to be expected. Lined cast iron pipe is made in sizes from 1¼ to 84 inches.

**Various types of linings are available to meet various conditions and preferences of users.*

CAST Q IRON

Look for the "Q-Check" Registered trade mark.

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CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

thinking cap of one associated with any of the other industries above listed. Then see whether he does not feel that each one is an industry just as vital to defense, if not more so, than water supply. Of course, he may be wrong, but his error will help you to see how difficult it can be to sell Washington the idea of unlimited priority for water works because the men there are not water works men either.

All in all two things are evident. First, water supply is getting as much preference as any civilian service and second, no news of any water plant having failed to get any vital material after it had properly presented its case has reached A. W. W. A. headquarters. It is true that unnecessary extensions are not being made and that substitute materials are being used instead of special materials. In the meantime, people are learning their way around the use of the priority system and being reminded that their neighbors can help.

And for the time being it does not appear proper to advocate special privilege and automatic blanket priority for public water supply. Things have changed from what they were three months ago. They may change again and if it develops that any fundamental impairment of water service is threatened and blanket priority for water works is the answer, then we can support blanket priority.

But let us be loyal Americans and good water works men at the same time—and always put the little end of the telescope to our eye—not the big end. Using a telescope properly not only keeps perspective, but helps us to see things a long way off.

Edwin W. Barbee, Water Purification Engineer of the San Francisco Water Dept., has been appointed to extended active duty in the U. S.

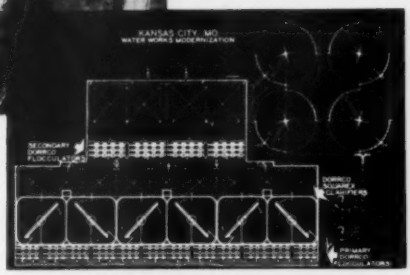
(*Continued on page 6*)

C. E. Rhyne, Superintendent of Water and Lights, Gastonia, N. C., died at the age of 53 on July 25, a few hours after he had undergone an operation for the removal of a growth from his throat. Although Mr. Rhyne had been in ill health for some time, he had continued with his work and had been at the city hall the day before his death.

He was a native of Gastonia, where he spent all his life, except for a brief period during and immediately following the World War when he was affiliated with shipyards in Philadelphia and, later, when he studied electrical engineering in Chicago. He first worked for the city water and light department in 1914. He became Superintendent in 1919. Mr. Rhyne had been an Active Member of the A.W.W.A. since 1922.

THE KANSAS CITY WATER WORKS

▼ Kansas City Water Works today. In foreground plain basins to be Dorr-equipped. In background, existing Dorr Clarifiers for presedimentation.



▲ Details of the modernization program.

Modernized with Dorr Clarifiers & Flocculators for 100-150 M.G.D. of Softening

★ Away back in 1926, we supplied Kansas City, Missouri, with 4 Dorr Clarifiers, each 200 feet in diameter, for presettling raw Missouri River water ahead of plain coagulation and filtration.

Now in 1941, Kansas City is modernizing—going to softening, too—installing flexible Dorr units for continuous flocculation and sedimentation in the existing plain basins. All this at a small fraction of the cost of a new installation with new tanks.

Dorreo Squarex Clarifiers and Flocculators are ideal running mates in old plants as well as in new ones. Square sedimentation units, installed thus in multiple, mean inexpensive unit tank construction—a pleasing compact layout—and a minimum of interconnecting pipe lines and channels.

● *Water works served now by plain basins can profit from a Dorr modernization program. Size and shape of existing tanks are no handicaps to Dorr Clarifiers and Flocculators.*

Primary Flocculation—6 units of Dorreo Flocculators (each 165′ × 55′ × 18′)

Secondary Flocculation — 2 units of Dorreo Flocculators (each 257′ × 54′ × 17′)

Secondary Sedimentation—6 Dorreo Squarex Clarifiers (155′ square × 15′4″ side depth)

Cons. Engrs: Black & Veatch
Burns & McDonnell

FACTS ON THIS PROJECT

Type: Presedimentation followed by softening.
Capacity: 100 M.G.D., at present; 150 M.G.D. in future.
Source of Raw Water: Missouri River
Raw Water Turbidity: 200-10,000 P.P.M.
Raw Water Hardness: 175-300 P.P.M.
Treated Water Hardness: 90 P.P.M.
Reagents: Lime, alum, iron, chlorine, CO_2.

The DORR COMPANY Inc.
ENGINEERS · 570 LEXINGTON AVE. · NEW YORK
ATLANTA TORONTO CHICAGO DENVER LOS ANGELES

(*Continued from page 4*)

Army as Second Lieutenant, 62nd Transport Group, Air Corps, McClelland Field, Sacramento, Calif. Before his military leave from the Water Dept., Mr. Barbee had been in charge of operation and maintenance of purification equipment.

The U. S. Civil Service Commission has announced that civil service appointees are needed to serve as plant inspectors under a plant protection inspection service recently established by the War Department. Only persons who can meet high personal and professional standards will be considered for these positions which pay from $2,900 to $4,600 a year. Persons most eligible are those who have had full-time responsible experience as fire marshal or inspector of a large city fire department, investigator of large industrial installations for a fire or indemnity insurance company, safety director in a large commercial establishment, technical safety engineer or consultant, or as plant engineer with responsibility for a plant-wide safety program.

(*Continued on page 8*)

WE'VE GOT EVERYTHING!
for your MODERN water treatment plant

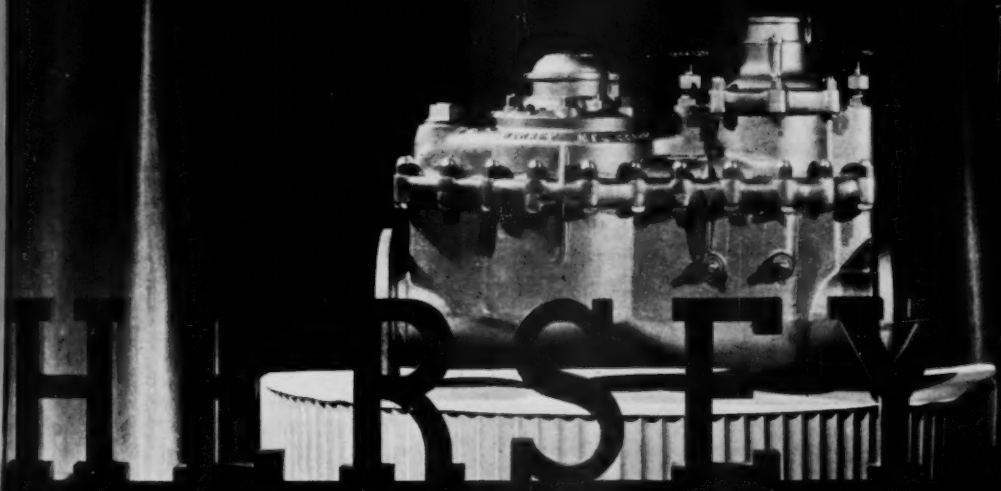
GAUGES
COAGULATORS
LEVEL CONTROLLERS
UNDERDRAINS
Lime Slakers
You can call on INFILCO for modern water purification equipment of every type and size. And, by standardizing on INFILCO products you can place undivided equipment responsibility in the hands of a single manufacturer.
INDICATORS
Samplers
AERATORS
Write today for Bulletin 60—"INFILCO Equipment for Municipal Water and Sewage Plants."
Chemical Proportioners
Softeners
Hydrodarco Purifiers
Operating Tables
FILTERS
Chemical Feeders

INFILCO
INTERNATIONAL FILTER CO.
325 W. 25TH PLACE, CHICAGO, ILL.
INFILCO

No Compound Meter nor assembly of meters can equal the Hersey Compound Meter

and only

Hersey can make a Hersey Compound Meter



HERSEY

HERSEY MANUFACTURING COMPANY
SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK PORTLAND, ORE. PHILADELPHIA
ATLANTA DALLAS CHICAGO SAN FRANCISCO LOS ANGELES

(*Continued from page 6*)

By furnishing information on water resources, the U. S. Geological Survey has played a large role in the extensive defense construction and industrial expansion. We are indebted to David G. Thompson, Senior Geologist of the Geological Survey, for much information and are glad to present it here.

During the past fiscal year the Division of Surface Water of the Geological Survey responded to more than 500 requests from Federal agencies, consulting engineers, manufacturers, and others, for information about surface-water resources for defense projects. About half of these were received by the 41 field offices of the Geological Survey and the remainder by the Washington office.

The Division of Ground Water furnished information in regard to more than 300 localities. About half of these were from the Office of Production Management, about 85 from the War Department, and about 25 from the Navy Department. Field investigations were made in approximately 25 localities.

In a large percentage of these requests, relating to both surface and ground water, information was also furnished in regard to the quality of the water resources.

The information furnished by the different divisions of the Water Resources Branch has involved areas in practically all the States, the Territories of Alaska and Hawaii, Puerto Rico, and British possessions in the West Indies in which naval bases are being established. It has related to projects that have involved quantities of water ranging from only a few gallons a minute for the personnel of a radio monitoring station to 100,000,000 gallons a day for a powder plant. Of particular value has been a monthly press release by the Division of Water Utilization, showing current stream-flow conditions at a selected group of gaging stations throughout the country. This information was issued weekly during critical drought periods.

(The Geological Survey has warned that it is not now always safe

(*Continued on page 10*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

ZEOLITE CHEMICAL CO.
90 WEST STREET NEW YORK, N. Y.

The A.B.C's of Good Connections

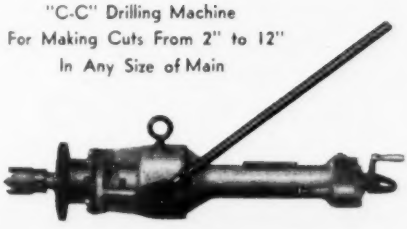
A. Will Withstand Severe Strains.

B. Actually Strengthens and Supports the Main.

C. Easily and Quickly Installed.

H-655 Tapping Valve

H-605 Tapping Sleeve



"C-C" Drilling Machine
For Making Cuts From 2" to 12"
In Any Size of Main

Mueller Tapping Sleeves have been designed extra strong and rugged. Scientifically placed ribs reinforce the heavy wall thicknesses to give even greater strength where it is needed most. The largest possible number of large diameter, rust-proofed bolts are used to draw the two halves together to a permanent, leak-proof joint. Mueller Tapping Valves are made of the highest grade grey iron and are fully bronze mounted to insure years of trouble-free service. Write us concerning your requirements.

MUELLER CO.
Decatur, Ill.

MUELLER CO.
DECATUR, ILL.

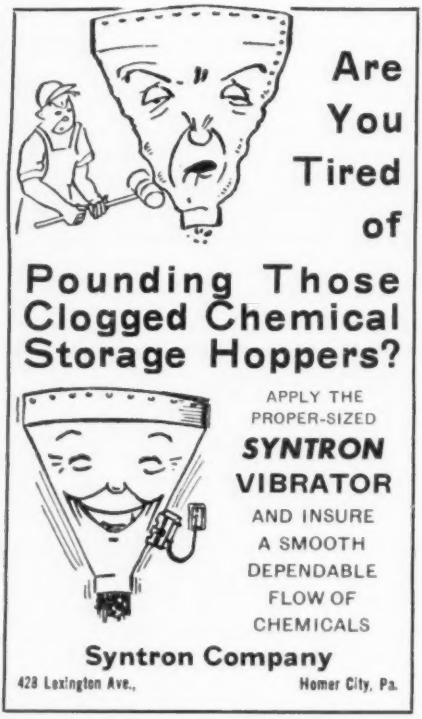
(*Continued from page 8*)

to rely upon reports of a few years past where ground water is concerned —due to increased pumpage, etc. The Survey is ready, however, to supply results of investigations as far as they are available at any time.)

A Code for Measurement of Water Using Standard I. S. A. Orifices with Free Discharge has just been published by the Hydraulic Institute. It was prepared by the Standards Committee of the Hydraulic Institute's Deep Well Turbine Pump Section, assisted by the Engineering Department of the University of California. The Hydraulic Institute has released the following observations about the Code:

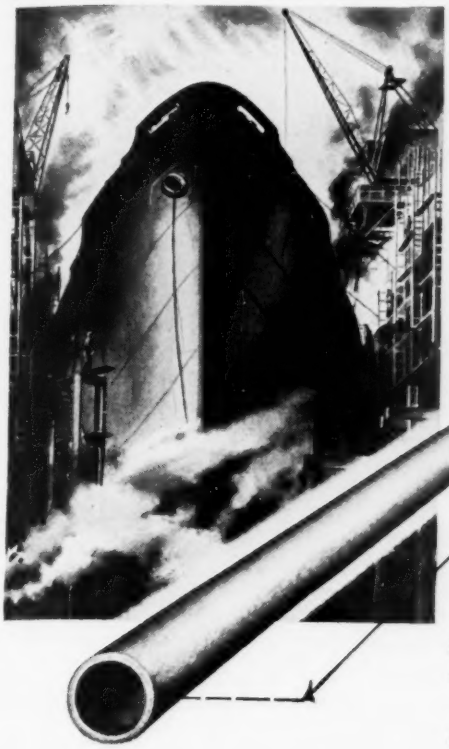
"As conditions in the field do not permit an ideal set-up like that in a laboratory, the results are less accurate. Based on experiments, limits of deviation are given for the evaluation of the readings for field conditions. This Code was therefore prepared for all manufacturers of deep well turbine pumps as a guide for the measurement of capacity in the field in testing deep well turbines when higher precision capacity measuring equipment is not available. This Code contains specifications for a single preferred construction of orifice and orifice holder, and shows three preferred

(*Continued on page 12*)



HIGH QUALITY
VALVES
HYDRANTS

M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.



★ ★ ★ ★

New 18-foot lengths

of K&M *"Century"* Pipe speed defense project

In Pascagoula, Miss., government ship construction is being rushed at "top speed." A housing project for the many new workers made it necessary to build a complete water system as fast as possible. It was logical to choose Keasbey & Mattison "Century" Asbestos-Cement Pipe, because it is quickly installed.

There were 40,437 feet of "Century" Pipe used on this job, much of it in the new 18-foot lengths. These lengths are available in sizes 6" and 8", class 150. Besides being light and easily handled without mechanical equipment, these 18-foot lengths require 113 fewer joints per mile, a saving of 28% that is quickly reflected in installation time and costs.

In Pascagoula one saving in laying cost was realized in connecting to fire hydrants. Hydrants were to be placed 21 feet from the main. A 3-foot nipple of "Century" Pipe was attached to the hydrant before it was lowered into the trench, then the connection to the main was completed with one 18-foot length. This saved time in making joints.

"Century" Asbestos-Cement Pipe gives trouble-free service under the most difficult conditions. It never tuberculates or corrodes. The joints are easily made and they stay tight. "Century" Pipe is light to handle and fast to install. Permanently smooth bore reduces your pumping costs.

Write Dept. 1017 for free booklet, "Mains without Maintenance."

KEASBEY & MATTISON

COMPANY, AMBLER, PENNSYLVANIA

(*Continued from page 10*)

orifice sizes for each pipe size. With these limitations, it was possible to prepare charts giving the flow in g.p.m. as a function of the head on the orifice."

The Code is in two parts, covering, respectively, application of the meter and construction specifications. Charts, tables and illustrations are also included in the Code, which is available for $1 per copy from the Hydraulic Institute, 90 West St., New York, N. Y.

Water customers are now paying $815,326,000 annually for water served them in 84 U. S. cities of over 100,000 population where the systems are municipally owned, according to Census Bureau information. Chief outlays of these departments are $74,502,000 for operating expenses and $63,331,000 in capital outlays. Interest payments, pensions and *contributions to general city funds* constitute other important items of cost. Also noted is the fact that there are only eight U. S. cities of over 100,000 which do not own and operate their own water service—Birmingham, Bridgeport, Chattanooga, Gary, Indianapolis, New Haven, Scranton and Peoria.

(*Continued on page 14*)

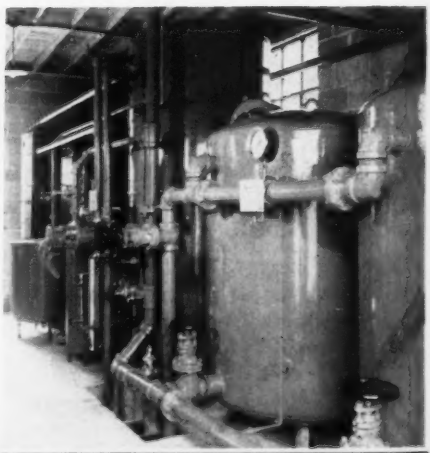
WATER PROBLEMS SOLVED

in

Warrensburg, Illinois

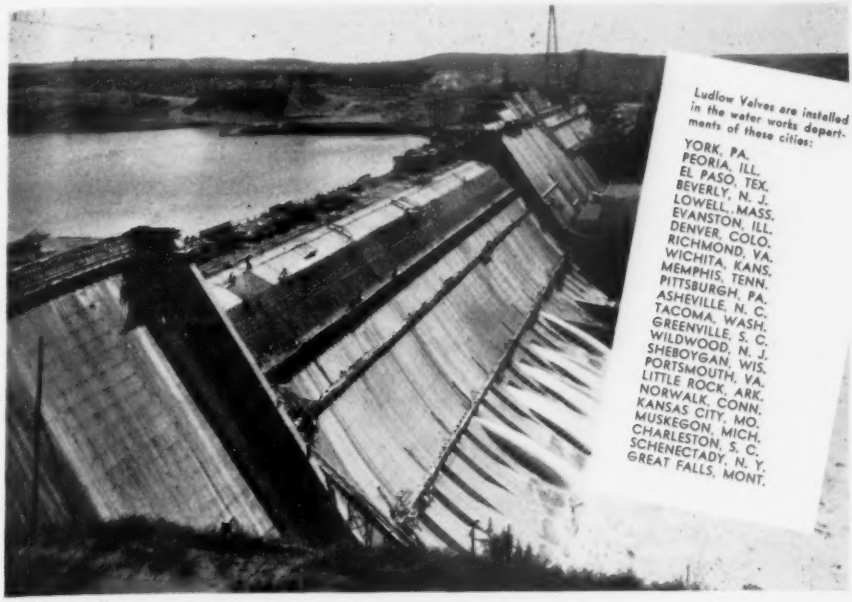
One of America's finest installations of water conditioning equipment for small municipalities was recently completed at Warrensburg, Ill., by the Refinite Corporation.

Water problems included a high content of dangerous methane gas, 21 grains of hardness and 1.3 p.p.m. of iron. The Refinite equipment shown at right now turns out gas-free, five-grain water with less than .2 p.p.m. of iron. Refinite engineers can surmount *any* municipal water problem. Let us help you!



★ THE REFINITE CORP.

REFINITE BLDG. RIVAL OF THE CLOUDS OMAHA, NEBR.



Elwood M. Payne Photo

LUDLOW VALVES AT WORK

Ludlow Valves are the standard choice of water works departments in many cities. Installed throughout the entire system, they assure the unfailing and economical service that is essential to the safety and health of the cities they serve.

Ludlow developed and perfected the principle of the double-disc parallel seat valve. This construction offers positive closure, easy operation, self-cleaning seats, and easy replacement of parts. Many Ludlow Valves are still in service after as many as 40 or 50 years of operation.

LUDLOW SLIDE GATE HYDRANTS. The slide gate principle insures complete security in fire hydrants. Ludlow Hydrants provide *quick water* with least possible shock, proper drainage, no flooding, and easy inspection and servicing. Ludlow Valves and Hydrants are fully described in Catalog No. 201. Write for a free copy today.

LUDLOW VALVES

THE LUDLOW VALVE MFG. CO., INC. • TROY, NEW YORK

(*Continued from page 12*)

New Materials and Gadgets

1. A new photoswitch electronic level control is now available for single level control and indication, on and off pump-up and pump-down control at two levels, boiler feedwater control and low level safeguards. Easy installation and maintenance are claimed due to a lack of mechanical floats and pressure switches.

2. Cooking and other wares are now being developed of glazed porcelain in an effort to help replace scarce metals. It is reported that test pieces of the ware have withstood four cycles of heating to redness, then quenching in cold water, before breaking—and with no crazing noted.

3. For timing precisely and controlling two to eight repeated sequences in plant processes, there is now a controller which utilizes, besides the usual clock mechanism, an aluminum disk carrying a scale in which holes are punched with an ordinary ticket punch. The superintendent can thus readily establish the cycles.

4. A new electronic micrometer has been developed to gage soft compressible materials to 0.00005 in. It operates by the micrometer tip being brought into contact with a metal rider resting on the material, so before any pressure has been exerted, an electronic circuit flashes a signal.

5. A new portable lighting unit has been built for towing behind a small truck or auto so that an independent and flexible source of light may be had wherever needed. Four 1,000-watt wide-angle floodlights are supplied by a 5,000-watt self regulating d.c. generator driven by an air cooled engine equipped with electric starter.

6. A ten-key subtractor is a new "adding" machine which also does repeat subtraction, punctuates automatically and automatically double spaces after totals are taken.

7. For protecting iron and steel, a new rubber base paint has been developed and which is said to brush well, dry fast and be resistant to water and chemicals.

Readers can obtain further information by sending a postal to the A. W. W. A. headquarters giving the reference numbers of any of the above items and citing the September issue as the source.

(*Continued on page 16*)

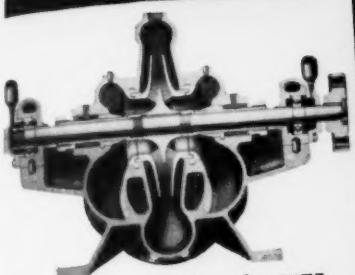
40 Years' Progress

IN CENTRIFUGAL PUMP DESIGN

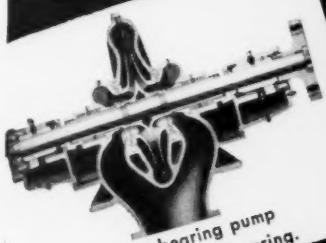
The modern-style, high quality centrifugal pump for motor and turbine speeds, with horizontally split casing, LABYRINTH WEARING RINGS, and removable wearing parts, was introduced by the De Laval Steam Turbine Company in the year 1901.

Advanced methods and equipment for interchangeable manufacture, including jigs, special machine tools and limit gages, were at the same time provided to make possible accurate and high-quality production.

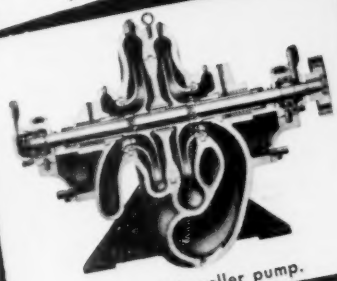
The De Laval Engineering Department has concentrated continuously during 40 years upon the problems of centrifugal pump design and application. This specialization places at the user's command a complete, modern line of highest quality pumps and a vast store of knowledge and unsurpassed expertness in solving pumping problems. State conditions of use and ask for Publication P-3223.



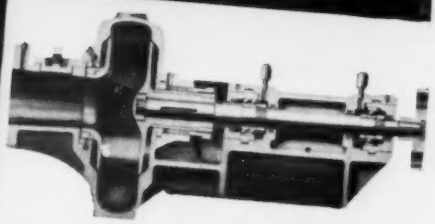
Single-stage double-suction pump with ball bearings.



Sleeve-bearing pump with ball thrust bearing.



Opposed impeller pump.



Clogless pump.

DE LAVAL STEAM TURBINE CO., TRENTON, N. J.

(*Continued from page 14*)

D. S. Abell, Principal Assistant Engineer of the North Carolina State Board of Health, has left that position to become Chief Engineer and Director of the Bureau of Sanitation in the Alabama Department of Public Health. Mr. Abell served nine years with the North Carolina Department, where he was interested primarily in water, sewage and general public health engineering problems. Before that he served for four years under F. H. Waring in the Ohio State Department of Health. He has served as Vice-Chairman of the North Carolina Section of the A. W. W. A. and has been very active in its affairs. He has also been President of the North Carolina Section of the American Society of Civil Engineers, and of the Raleigh Engineers Club.

The Annual Georgia Water & Sewage School will be held in Atlanta at the Georgia School of Technology on October 22–25. Further information can be obtained from W. H. Weir, Associate Director of Public Health Engineering of the State Department of Health, Atlanta.

The Philadelphia water system is being improved by a $3,859,843 repair project carried out by W.P.A. Workers are making a leak survey of the system's 13,000,000 ft. of mains and are over-hauling or making improvements on the city's six filtration plants which have a capacity of 350 m.g.d. Besides supplying important defense industries, the city system supplies the Philadelphia Navy Yard, Fort Mifflin, Frankford Arsenal, the Quartermaster's Depot, and the Schuylkill Arsenal.

Licensing of water works operators has now been given formal legislative authority by the passage of the Michigan Senate Bill No. 248 which has been signed by the Governor. Since 1931 certification of operators in treatment plants has been in effect under a regulation of the State Health Dept., and according to John M. Heppler, Director of the Bureau of Engineering, this practice has been favorably received. It will be noted

(*Continued on page 18*)

ATTENTION WATER WORKS MAINTENANCE ENGINEERS

This product will save you time — labor — money

QUIGLEY TRIPLE-A PROTECTIVE COATINGS are technical products made to give real protection under conditions that quickly destroy paints. Thousands of plants use TRIPLE-A Protective Coatings for better protection, less maintenance and longer life for steel-work. Each TRIPLE-A Coating has distinctive properties and applications. Nos. 10, 20, 32 and 44 CAN BE APPLIED ON DAMP SURFACES. Impressive service records in worldwide installations offer proof of the merits of TRIPLE-A.

Write for Bulletin #375

QUIGLEY COMPANY, Inc.

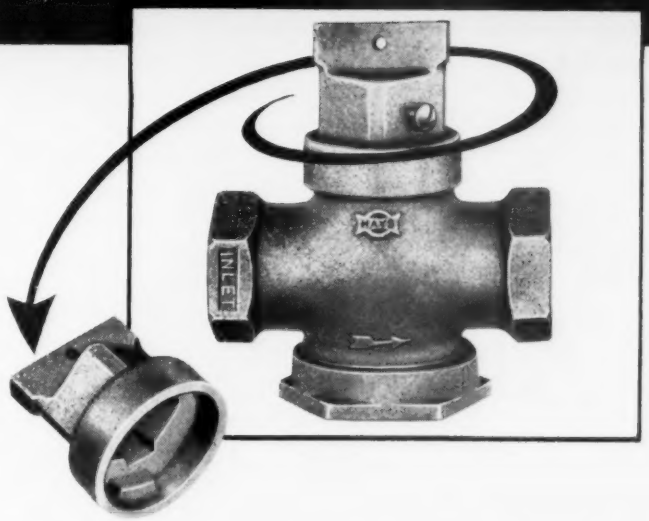
56 WEST 45TH STREET • NEW YORK, N. Y.

Makers of Hytempite

Distributors with Stocks and Service in Important Industrial Centers Throughout the United States, Canada, and in 32 Other Countries.

FOR YEARS HAYS

HAS SUPPLIED COMBINATION CAP AND TEES



WHEREVER THIS EXTRA PROTECTION IS PREFERRED

•

MANY cities standardize on Hays Combination Cap and Tees with all styles of Hays Inverted Key Stops. This positive method of keeping sand and grit away from ground surfaces adds to the efficient life of these stops. The all brass combination Cap and Tee handle is interchangeable with separate Cap and Tee Handles on all Hays Inverted Key Stops. Specify size and style of inverted key stop to be covered. Stops complete with combined Cap and Tee are available in sizes 1/2, 5/8, 3/4, 1, 1-1/4, 1-1/2 and 2".

Write for Catalog Section 5.

HAYS MANUFACTURING CO., ERIE, PA.

COPPER • BRASS • LEAD • IRON

HAYS *Water Works* PRODUCTS

HAYS MFG. CO., ERIE, PA. • *Since 1869*

(*Continued from page 16*)

that the new bill repeals former legislation and that it contains a "grandfather clause."

"An act providing for the supervision and control by the state board of health over waterworks systems and sewage disposal systems, for the classifying of water treatment plants for the examination, certifying, and regulation of persons in charge of such water treatment plants, and providing for the appointment, duties, salary and expenses of a state sanitary engineer, and providing penalties and defining liabilities for violations of this act; and to repeal Act No. 28 of the Public Acts of 1909.

"Sec. 3. The state board of health shall have authority to make and enforce such rules and regulations as it may deem necessary, governing and providing a method of conducting and operating the entire or any part of the systems of waterworks, including the filtration plants, owned or operated by such corporations, partnerships or individuals. Such board shall classify water treatment plants with due regard to the size, type, location, and other physical conditions affecting such plants and according to the skill, knowledge, experience, and character that the person in active operating charge must have to successfully operate said plants and to maintain

(*Continued on page 20*)

DOUBLE-LID
METER BOX COVERS

Ford double-lid meter box covers provide dead-air insulation in neck of cover and conserve heat in the meter box. Top lids are provided with the Ford Worm Lock. Write for catalog of meter box covers, double and single lid.

The Ford Meter Box Co.
WABASH, INDIANA

Filter Sand and Gravel

WELL WASHED AND CAREFULLY GRADED TO ANY SPECIFICATION.

PROMPT SHIPMENT IN BULK OR BAGS OF 100 LBS. EACH.

Inquiries Solicited.

Northern Gravel Co.
P. O. Box 307, Muscatine, Iowa

Peerless Pumps
—AS THEIR NAME IMPLIES
Acknowledged leaders in their field
HI-LIFT, TURBINE & HYDRO-FOIL
TYPES—capacities up to 100,000 g.p.m.
Ask for Literature
PEERLESS PUMP DIV. - Food Machinery Corp.
Factories: Los Angeles, San Jose, Fresno, Calif., Canton, Ohio

STEEL PIPE wins friends on these five counts

Why are more and more cities specifying ARMCO Spiral Welded Steel Pipe for water supply mains? The reason is clear. Sturdy ARMCO Pipe wins favor on these five important counts.

Low Installed Cost

ARMCO Spiral Welded Pipe is amply strong yet not burdened with excess weight. You save on hauling, handling and installation. Long 50-foot sections mean fewer joints, less assembly work.

Freedom From Breakage

ARMCO Pipe has an ultimate strength of 50,000 to 60,000 pounds per square foot. It stretches 25 to 30 per cent before breaking.

Low Leakage Loss

You can prevent loss of revenue and curb excessive pumping costs by specifying "Spiral Welded." Strong tight joints are assured with any type coupling or by field welding.

High Flow Capacity

Bid good-bye to costly cleaning of water mains. ARMCO Pipe with a spun enamel lining assures highest possible flow capacity. This lining definitely prevents tuberculation.

Low Cost Per Year

Specify "Spiral Welded" with every assurance it will last as long as you need it. In the long run ARMCO Pipe costs less per year because of its efficient, reliable service.

Write for Information

See for yourself how ARMCO Spiral Welded Pipe can help cut water transportation costs. Diameters run from 6 to 36 inches; wall thicknesses from 7/64 to ½-inch. Write us. The American Rolling Mill Company, Pipe Sales Div., 2771 Curtis St., Middletown, Ohio.

ARMCO ARMCO **SPIRAL WELDED PIPE**

Steel Pipe . . . An Old Product Made Better • Meets AWWA Standard Specifications

(*Continued from page 18*)

the public health. Such board shall examine persons as to their qualifications to operate such plants and issue and revoke certificates for such persons, adopt rules and regulations regarding the classification of such plants and the examinations for certificates for the operators of such plants and issuance and revocation of such certificates. Every water treatment plant subject to the provisions of this act shall within 30 days after the effective date of this act or within such longer period as the board shall prescribe, be under the supervision of a properly certified operator: provided, however, that nothing herein contained shall prevent such corporations, both municipal and private, partnerships and individuals from continuing to employ in such capacity any person now in responsible charge of the operation of a water treatment plant. And said board shall, in addition to the other powers herein vested in it, whenever it shall deem it necessary for the protection of health, have authority to direct such corporations, partnerships or individuals operating waterworks systems to cleanse any portion of such systems as it may deem necessary, and to operate the same in such manner as to furnish pure and wholesome water, and to enforce such directions by rule or regulations."

(*Continued on page 22*)

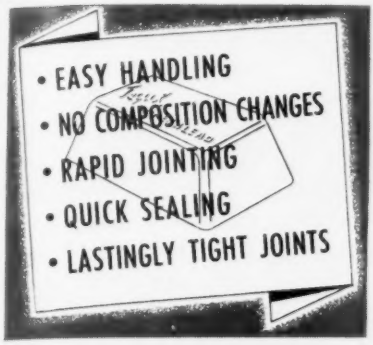
JUST A FEW BUILDERS FIRSTS!

BUILDERS made:

The **FIRST** commercial Venturi Tube
The **FIRST** Venturi Registering Instrument
The **FIRST** Venturi Meter for Sewage
The **FIRST** Venturi Rate of Flow Controller
The **FIRST** Venturi Controlled Chemical Feed Proportioner
The **FIRST** Differential Loss of Head Gauge with Stationary Dial
The **FIRST** Air Transmission System for Actuating Venturi Instruments
The **FIRST** Time Impulse Telemetering System for Flow and Level

Descriptive Bulletins covering meters and controllers available.

BUILDERS - PROVIDENCE, INC.
(DIVISION OF BUILDERS IRON FOUNDRY)
PROVIDENCE . . . RHODE ISLAND



This, concisely put, is what you get when you use *Tegul*-MINERALEAD in jointing your Bell and Spigot Pipe • The ingot form is impervious to rain and flood • This compound works with pipe of any diameter, isn't bothered by terrain conditions and has the stamina to withstand far greater vibration and punishment than it will ever meet in service • The cost will surprise you pleasantly • For complete information, write The ATLAS MINERAL Products Company of Pa., Mertztown, Pennsylvania.

Tegul MINERALEAD

For Jointing BELL & SPIGOT PIPE

For Underground Service Lines

ANACONDA COPPER and RED-BRASS

Anaconda Copper Tubes in straight lengths and coils... Anaconda "85" Red-Brass in straight lengths only – both are products of dependable quality. Made by the world's largest and most experienced manufacturer of copper and brass, and stocked by leading supply houses.

3924

THE AMERICAN BRASS CO.

General Offices: Waterbury, Connecticut

A critical problem solved with

2 3/8" O.D.

SHATTER-PROOF

MACHINE LINED-COATED-AND-WRAPPED STEEL PIPE

ANOTHER

HILL-HUBBELL

ACHIEVEMENT

The shortage of non-ferrous metals makes it difficult to get galvanized pipe and copper tubing.

Our answer to this problem is a new development in the HILL-HUBBELL method of Multi-Coat Akwalining steel pipe in small sizes. Shatter-proof steel pipe as small as 2 3/8" O.D. can now be spun lined, coated-and-wrapped at the mill. It embodies all the merits of larger "shatter-proof" steel pipe.

SCHEMATIC CONSTRUCTION OF SPECIFICATION TAX-1

GENERAL PAINT CORPORATION

HILL, HUBBELL & CO. • Division • Cleveland, Ohio

EXPORT OFFICE: SAN FRANCISCO, CALIFORNIA, U. S. A.

(*Continued from page 20*)

"**Workman Electrocuted**" is the title of a brief story which accompanies an article on the use of extension lead cords in The Water Analyst of August, 1941, published by the Atlantic Utility Service Corp. of Reading, Pa. The story and article follow:

" 'The body of Harry Smith, 60, of New Brighton, N. Y., Handyman of the Penn-Beaver Hotel, who had been missing since Wednesday noon, was found in a boiler at the hotel yesterday. H. C. McCarter, Beaver County coroner, said Smith, who had been cleaning the boiler was apparently electrocuted by an extension light he was using.' "

"We have recently requested our Safety Department to furnish us with their recommendations regarding lead cords and have been advised that the heavy duty rubber covered cable known as Type S is the approved design. This cable is manufactured by a number of companies, the names of several of which are as follows:

	Type S
General Cable	"Super Service"
Simplex Wire and Cable	"Tirex"
Rome Cable	"Rome No. 60"
Okonite	"Okocord"

(*Continued on page 26*)

Announcing the approval of

Standard Specifications for:

• Elevated Steel Water Tanks, Standpipes and Reservoirs • Steel Water Pipe of Sizes of 4 Inches up to but Not Including 30 Inches • Cement Mortar Protective Coating for Steel Water Pipe of Sizes 30 Inches and Over

These standards, hitherto tentative, were approved by the Board of Directors at the Toronto convention of the A. W. W. A. in June 1941. *The Standard Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs* was prepared jointly by the American Water Works Association and the American Welding Society, and is available in paper-covered reprints, 52 pages, at $.30. *The Standard Specifications for Steel Water Pipe of Sizes of 4 Inches up to but Not Including 30 Inches* is reprinted under one cover with the *Standard Specifications for Electric Fusion Welded Steel Water Pipe for Sizes 30 Inches and Over*, both for $.25. The latter had been previously approved. *Standard Specifications for Cement-Mortar Protective Coating for Steel Water Pipe of Sizes 30 Inches and Over* is reprinted at $.20.

AMERICAN WATER WORKS ASSOCIATION

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One of the principal causes of chlorinating system ailments is "taffy"—the sticky gum caused by impurities . . . such as hexachloroethane, hexachlorobenzene and acetylene tetrachloride . . . in liquid chlorine.

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Pennsylvania Salt has developed a special fractionating column for producing taffy-free liquid chlorine. And to make sure that you get the dependable service you want, Pennsylvania Salt supplies this improved liquid chlorine in double-checked cylinders . . . twice inspected and tested for leaks . . . clean and in perfect working condition.

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Help Build up Your Association by Bringing in a New Member

SEND FOR APPLICATION BLANK

AMERICAN WATER WORKS ASSOCIATION
22 East 40th St.
NEW YORK CITY

(*Continued from page 22*)

"Attention is directed to the fact that sockets should be adequately insulated and under no circumstances should a bare metal socket be employed. The C & E Safety sockets distributed by the Industrial Products Co. are among those which the Safety Department recommends for use. In connection with the matter, attention is directed to safety rule Section 4, Article 4(f) and Article 5(e) relating to extension cords, which read as follows:

Article 4(f)—Portable extension cords shall be maintained in first class condition at all times. Lamp sockets shall be adequately insulated and equipped with suitable guards.

Article 5(e)—When working in boiler, employees shall assure themselves that electrical lighting equipment is adequate. Wiring, lighting units and extension cords and lamps shall be properly insulated to protect men from contact with the electrical current. It is recommended that the frame of electric tools be grounded while in use. This can be accomplished by means of a spare conductor in the extension cord or cable. No volatile inflammable shall be used for cleaning purposes. Oil waste or oil saturated clothing shall not be permitted inside any boiler drum. Open flames shall not be allowed

(*Continued on page 28*)

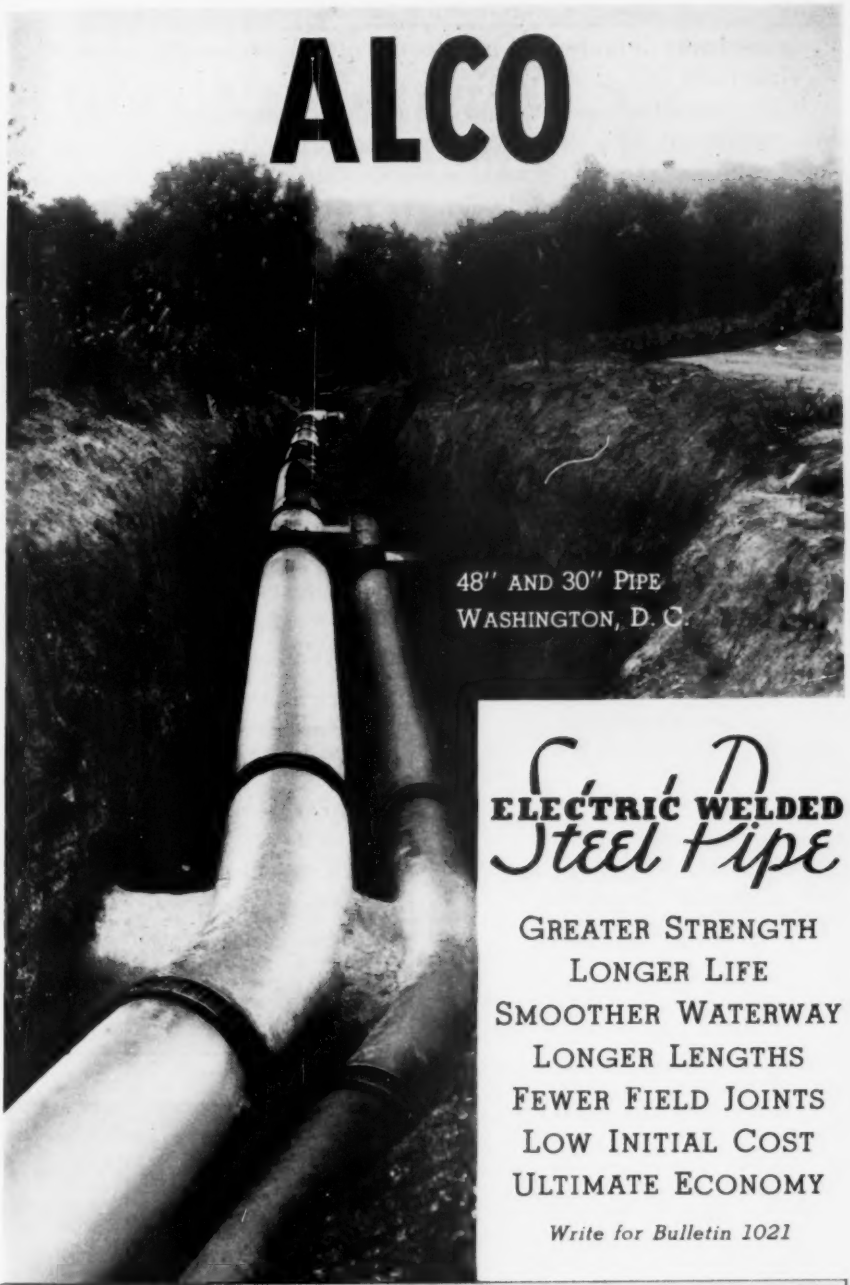
SEVEN IN ONE

And They All Add Up to a Good Time!

1. Sunrise breakfast . . . yes sir . . . with round table discussions by sewage works operators.
2. Interesting and outstanding meetings . . . ones that you'll like.
3. Presentations of papers by outstanding leaders of the country. Don't miss hearing them.
4. Exhibits of new sewerage and sewage equipment and material.
5. Inspection trips to one or more of New York's new sewage treatment works.
6. Smoker. (Don't miss it . . . it will be great.)
7. Annual banquet with dancing and plenty of entertainment. *Bring the ladies.*

ATTEND THE SECOND ANNUAL CONVENTION
FEDERATION OF SEWAGE WORKS ASSOCIATIONS

New York City ***October 9th, 10th and 11th***



ELECTRIC WELDED
Steel Pipe

GREATER STRENGTH
LONGER LIFE
SMOOTHER WATERWAY
LONGER LENGTHS
FEWER FIELD JOINTS
LOW INITIAL COST
ULTIMATE ECONOMY

Write for Bulletin 1021

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(Continued from page 26)

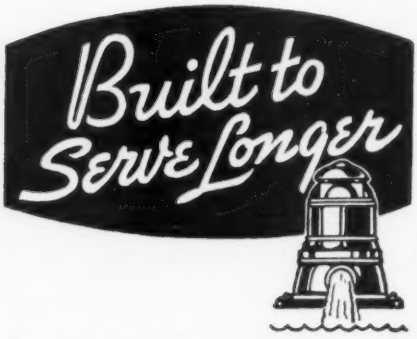
inside boiler drum (except in cases where it is necessary to use welding equipment).

"Approximately one year ago, the Safety Department distributed a pamphlet describing a device known as the Safety-Tran. This is an air cooled transformer which is used in connection with extension cords and reduces the voltage to 32 or 6 volts. It is their suggestion that this type of device be used for extension lights for working in boiler and in damp or otherwise hazardous locations.

"There have been a number of accidents of this character which have gained wide prominence as a result of fatalities which occurred with the assumedly "safe" 110 volt circuits. Under the proper conditions, these circuits can and have resulted in cases of fatal shock. Properly selected safe equipment, carefully maintained and used with a knowledge of the hazards involved, will facilitate the elimination of accidents of this kind. Copies of this paper will be supplied to interested parties requesting them in the near future."

Chain Belt Company of Milwaukee has announced several changes in personnel recently. W. B. Marshall who has been Assistant Sales Manager

(Continued on page 30)



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99 Per Cent Pure Silica
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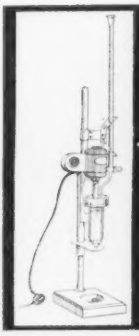

The Langelier Motorized Water Hardness Apparatus

For the rapid and convenient determination of Calcium and Magnesium separately or in combination.

Write for descriptive folder

Chemlab Specialties Co.
52 Alvarado Rd., Berkeley, Cal.

OZONE solved
Whiting's acute taste and odor problem

AT A NET OPERATING COST OF ONLY $1.99 PER MILLION GALLONS!

THE Whiting taste and odor problem arose from a combination of diversified industrial wastes, such as steel, oil, corn products, soap, glue, and chemicals, plus sanitary sewage polluting Lake Michigan near the Whiting intake.

Only ozone of the chemical processes tried, succeeded in removing to a satisfactory degree the kerosene and phenolic tastes accentuated by the heavy chlorine dosages needed for sterilization.

Ozonation, as shown in the table below, has reduced the peak finished threshold odor numbers by 50 per cent.

The table, however, fails to tell the whole story. The conventional threshold odor test only measures the intensity of an odor regardless of its characteristics. The quality of a taste and odor is of greater importance, for quality in the last analysis determines palatability. In the Whiting water, the quality of taste and odor has produced a very favorable customer reaction—thanks to ozone.

The results were tabulated during the period Oct. 1, 1940-March 31, 1941		THRESHOLD ODOR NUMBERS					
		RAW			FINISHED		
	No. of Tests	MAX.	MIN.	AV.	MAX.	MIN.	AV.
BEFORE OZONATION	57	220	7	35	40	4	12
AFTER OZONATION	66	275	45	66	20	6	11

The complete story of ozonation at Whiting, Indiana, is told in our Bulletin No. 104. A copy is yours for the asking.

Ozonation

OXIDIZES, PURIFIES . . . REMOVES BAD TASTES, ODORS, COLORATIONS

OZONE PROCESSES
INCORPORATED
1500 WALNUT STREET
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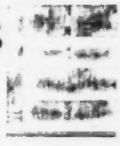

Ozone Processes, Incorporated, is an operating member of a well-established and soundly financed group, which has been serving American industry for over 60 years. The management is experienced and keenly aware of its responsibility to the Water Works Industry. This explains the thorough research and skilled engineering supporting every move we make in this field.

(*Continued from page 28*)

of the Conveying and Engineering Products Division has been made Sales Manager of the Division. Mr. Marshall has been associated with the Chain Belt Company since 1920. B. E. Sivyer, formerly Branch Manager at San Francisco, is now Assistant Sales Manager of the Chain Belt and Transmission Division with headquarters at Milwaukee and S. Y. Warner has replaced Mr. Sivyer at San Francisco.

J. Walter Snavely, District Manager in the Houston, Texas, territory for seven years, has returned to Milwaukee to serve in the Sales Dept. of the Conveying and Engineering Products Div. W. A. Pitts, formerly representative in Oklahoma City, has been appointed District Manager for oil well sales at Houston. George Hunt has also been appointed to the Houston district as District Manager of Industrial Sales.

Peerless Pump Division of the Food Machinery Corporation has announced the completion of the removal of its Eastern Offices and manufacturing facilities from Massillon, Ohio, to a new and modern plan located at 1250 Camden Avenue, S. W., Canton, Ohio. The new plant has been built because of an increase in defense and other orders. It has

(*Continued on page 32*)

MANUAL OF WATER QUALITY AND TREATMENT

ORDER NOW

The Manual of Water Quality and Treatment culminates many years of intensive investigation and is the absolute authority in its field. Price to members, $2.50; to members for cash with order, $2.25; and to non-members, $3.00. Write for your copy today.

American Water Works Association
22 East 40th Street, New York

The NEW and the OLD

This view plainly illustrates the difference between the new and the old method of providing storage in a waterworks system. The old standpipe at the right in the view is of small diameter. It will provide a good pressure in the mains *when it is full*, but when a few thousand gallons are used, the water level drops rapidly and the pressure decreases correspondingly.

The elevated tank is new and modern, even to its streamlined roof. The *entire* capacity is held *above* the top of the standpipe. The entire capacity is available at serviceable pressures.

CHICAGO BRIDGE & IRON COMPANY

BIRMINGHAM CHICAGO BOSTON NEW YORK
PHILADELPHIA HOUSTON HAVANA CLEVELAND
SAN FRANCISCO DETROIT TULSA LOS ANGELES

(*Continued from page 30*)

about 55,000 sq. ft. of floor space and is patterned after a new Peerless Pump Div. plant at Los Angeles. The building is of modern structural steel design and is completely air-conditioned for summer cooling and winter heating. Here will be manufactured Peerless Pump Div.'s entire line of pumps—turbine, propeller-type, and the Peerless Hi-Lift.

A trailer type mobile chlorinating unit, designed to provide positive protection of water supplies under emergency conditions or to meet other temporary needs for chlorination, has been introduced by Wallace & Tiernan Co. Inc., Newark, N. J.

The unit provides for closely controlled solution feed of chlorine over a wide range of application rates. Especially designed, the chlorinator employs the W & T vacuum principle. Powered by a 5 h.p. gasoline engine mounted on the trailer, a self-priming pump will deliver the required injector water at sufficient pressure to apply 100 lbs. of chlorine per day against a maximum pressure of 100 lb. per sq.in. in the main. Two 150 lb. chlorine cylinders are cradled in the trailer, connected in manifold to assure continuity of supply. The chlorinator is equipped

(*Continued on page 34*)

Large-Diameter
CAST IRON FITTINGS

(Below) Acipco 42" Ell
(Right) Acipco 42" Tee

Acipco produces a complete line of high-quality Cast Iron Fittings for use in pipe lines conveying either liquids or gases. Fittings for use in conveying liquids are furnished either with standard tar coating, or Enamelline or Cement-Lined as required. Fittings for use in conveying gases are furnished unlined and are carefully *air-tested.*

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM, ALA.

Pittsburgh Dallas Houston El Paso Chicago
Kansas City Minneapolis Cleveland
Los Angeles San Francisco New York City

STOP RUST
with
RUSTOP

Cathodic Protection ends rust
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Cleans old tanks
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Keeps new tanks clean
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No paint—No taste
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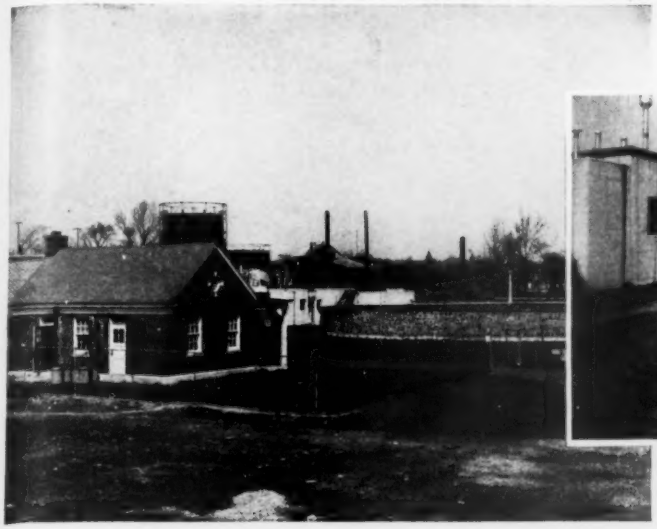
Write for estimate

ELECTRO RUST-PROOFING Company
29 W. Apple Street
Dayton, Ohio



G. L. Palmer, Superintendent

Stroudsburg, Pa. USES MATHIESON CHLORINE & HTH *for sewage treatment*

"(And)... we are completely satisfied," says Gilbert L. Palmer, Superintendent

● Mathieson Chlorine and HTH have been used in this modern sewage treatment plant at Stroudsburg, Pa. since the plant was first put in operation in 1937. Both products have been used continuously since that time . . . rendering "completely satisfactory" service. Mathieson Chlorine for post-chlorination and HTH in the dosing chamber for the elimination of filter flies—also for regular dosing of the beds.

Satisfactory service is an old story to Mathieson Chlorine and HTH. Stroudsburg is only one of hundreds of cities and towns that find Mathieson sanitation service both dependable and efficient. In Mathieson Chlorine you get *pure* chlorine and prompt delivery in well kept, trouble-free containers. HTH, also, in addition to its use on everyday sanitation jobs, should be kept on hand for quick emergency service requiring a mobile, high-test chlorine carrier.

Write us for full information on Mathieson Chlorine and HTH.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 100-lb. drums.

THE Mathieson Alkali Works (INC)
60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . AMMONIA, ANHYDROUS and AQUA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . CARBONIC GAS . . . SYNTHETIC SALT CAKE . . . SODIUM CHLORITE PRODUCTS

(*Continued from page 32*)

with a complete set of accessories including corporation cocks, hose, tubing and fittings for emergency use in connecting to mains, and with all the necessary tools for the work. A Comparator for making tests of chlorine residuals has a self-contained light source for use at night.

In the light of considerable data and information from British sources, this unit has been designed to meet emergency conditions as found in English experience during the past two years. It is designed to maintain accuracy of operation despite transport over long distances or rough roads. A retractable third wheel provides stability when disconnected from the towing vehicle. Gross weight complete including two 150 lb. chlorine cylinders is 2150 lb.

One of these chlorinators made the round trip from Newark to the A. W. W. A. convention in Toronto, behind an ordinary passenger automobile.

Specialists in defense emergency chlorination have been designated by W & T to study all available information from British sources. These men, especially qualified to survey chlorination needs with respect to emergencies, are available to supplement the work of regular field repre-

(*Continued on page 36*)

Cathodic Protection

The only positive method of preventing rusting, pitting and corrosion in steel water containers.

THE PATENTED

RUSTA RESTOR TRADE MARK REGISTERED

PATENTED & PATS. PEND.

METHOD

Steel Water Tanks
Filter Beds

For complete details write

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DIAPHRAGM PUMPS

Hand Operated--sizes 2", 2½", 3", 4"
Power Operated--sizes 3" and 4"

Open Discharge or Force Pump
Skid, Truck or Trailer Mounted

COMPLETE PUMP OUTFITS

Edson Pumps - Suction Hose
Brass Couplings - Bronze Clamps
Red Seal Diaphragms
Brass Strainer or Foot Valve
Hose Spanners - Adapters - Etc.

Also—Brass Hydrant Pumps

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New York, 142 Ashland Pl., Brooklyn

WATER METERS *Conserve* WATER RESERVES

WITH increased attention being focussed on the importance of adequate water supply for camps, for new industrial plants, industrial housing and fire protection, "Waterworks Preparedness" has overnight become a matter of national concern. Many years of experience show that Water Meters effectively conserve water reserves and prevent water shortage . . . by reducing useless waste. Water Meters help establish a conservative use of water. In many instances, they have enabled communities to postpone additions to existing water reserves or distributing equipment, in spite of additional demands or developments resulting in a perceptible diminution of the source of supply.

With the nation geared for a great undertaking, a heavy obligation falls upon water utilities. Among the most effective weapons at their disposal for waterworks preparedness are dependable Water Meters.

NEPTUNE METER COMPANY · 50 West 50th Street · NEW YORK CITY

Branch Offices in CHICAGO, SAN FRANCISCO, LOS ANGELES, PORTLAND, ORE., DENVER, DALLAS, KANSAS CITY, LOUISVILLE, ATLANTA, BOSTON.

Neptune Meters, Ltd., 345 Sorauren Avenue, Toronto, Canada.

Trident Meters for Waterworks Preparedness

(*Continued from page 34*)

sentatives and make recommendations in this aspect to any water works, without obligation.

The Emergency Chlorination Trailer will also serve for normal operation in main sterilization, secondary chlorination of reservoirs, dead-end flushing and other applications requiring a mobile unit. Temporary increased chlorination needs of sewage treatment plants constitute another expected point of service.

The Solvay Process Company, manufacturer of alkalies and nitrogen products, has recently established a separate Product Development Section with W. E. Blair, Manager and D. H. Ross, Assistant Manager. Headquarters of the new section will be at 40 Rector Street, New York City. Messrs. Blair and Ross, formerly associated with the executive office of Solvay Sales Corporation, will study the commercial usefulness of new Solvay products. Their work will involve cooperation with the research and technical sales groups, with view to promoting customer service.

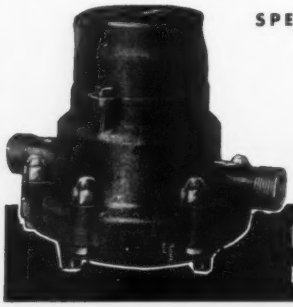
Wheelco Instruments Company, maker of various indicating and control instruments, has recently moved to its own building at Harrison and Peoria Sts., Chicago. The company has just published a 32-page booklet, "The Wheelco Thermocouple Data Book and Catalog—A Complete Manual for All Thermocouple Users." It is Bulletin No. S2–3.

Emphasizing the necessity for immediate national attention to post-emergency planning, the National Resources Planning Board today called on public and private agencies to start work now on the problem of transferring millions of men from "all-out production for defense to all-out production for normal living, when this war is over."

In a pamphlet—"After Defense—What?"—the Board expresses the view that "energetic and intelligent teamwork will make it possible for us

(*Continued on page 38*)

FIRST QUALITY METERS EXCLUSIVELY



SPECIFY *American* or *Niagara*
(BRONZE CASE) (IRON CASE)
Water Meters
WRITE FOR CATALOG

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.

1879—ROSS—1879

AUTOMATIC VALVES

Controls elevation of water in tanks, basins and reservoirs

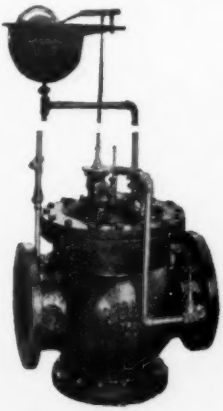
ALTITUDE VALVE

1. Single Acting
2. Double Acting

Maintains desired discharge pressure regardless of change in rate of flow

REDUCING VALVE

Regulates pressures in gravity and pump systems; between reservoirs and zones of different pressures, etc.



Maintains levels in tank, reservoir or basin

1. As direct acting
2. Pilot operated and with float traveling between two stops, for upper and lower limit of water elevation.

FLOAT VALVE

A self contained unit, with three or more automatic controls

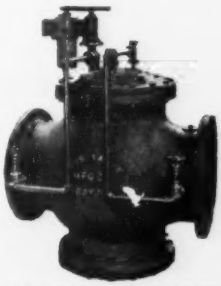
COMBINATION VALVE

Combination automatic control both directions through the valve

Maintains safe operating pressures for conduits, distribution and pump discharge

SURGE-RELIEF VALVE

Electric remote control—solenoid or motor can be furnished



REMOTE CONTROL VALVE

Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

Packing Replacements for all Ross Valves Through Top of Valve

ROSS VALVE MFG. CO., INC., P. O. BOX 593, TROY, N. Y.

(Continued from page 36)

to move from defense to peace while maintaining full employment" by increasing the national income, developing higher standards of living and by planning "to make Up-Building America the keynote of the post-defense program."

"The real problems of war never arise until after the war is over," said the Board. "When this war is won we can lose everything we are arming to defend, if, in the transition to peace, we slip back to a low national income with its inevitable unemployment, suffering, chaos and loss of freedom. To discover ways and to work out plans for shifting from full employment for defense to full employment for peace is a matter of outstanding concern.

"In this program government must take a leading part because it is the only representative of us all, the common meeting ground of all interests, and the one center of responsible coordinating power through which we can all act together."

The central objectives of post-defense planning are summarized in the statement as follows:

"1. We must plan for full employment, for maintaining the national

(Continued on page 40)

Economies in Office Forms
By Israel Rafkind

Recommended Practice for Distribution System Records
Committee Report

Coordinating Operating System Records With Accounting Records
By Nathan B. Jacobs

UNDER ONE COVER

These three documents, reprinted from the February, 1940, issue of the JOURNAL, constitute a basis upon which the head of any water department, whether it be large or small, may build an economical and practical system of keeping distribution records. The system recommended is wholly adequate, yet in no way burdensome. These outlines are compiled by authorities and should be in your hands today.—64 pp., $.25.

American Water Works Association
22 East 40th Street, New York

CLEAN YOUR WATER MAINS

One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

National Water Main Cleaning Co.

30 Church St., New York, N. Y.

BRANCHES

115 Peterboro St., Boston, Mass.
910 William Oliver Bldg., Atlanta, Ga.
7103 Dale Ave., St. Louis, Mo.
406 Florida Theatre Bldg., Jacksonville, Fla.
3812 Castellar St., Omaha, Neb.
205 West Wacker Drive, Chicago, Ill.
501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Canada

CUMULATIVE INDEX TO THE JOURNAL AND PROCEEDINGS

1881–1939 Inclusive

The Cumulative Index to the Journal and Proceedings of the American Water Works Association is ready for its place on your shelves, where it will render your bound volumes of these publications far more useful for ready reference. After this edition was printed the type was torn down, and future indexes will commence with the issue of January, 1940. Get your copy *now*. Price to members, $1.75; to members for cash with order, $1.50; to non-members, $2.00. Write to—

The American Water Works Association
22 East 40th Street, New York

(*Continued from page 38*)

income at 100 billion dollars a year at least, a point we shall reach by 1944, rather than to let it slip back to 80, or 70 or 60 billion dollars again. In other words, we shall plan to balance our national production-consumption budget at a high level with full employment, not at a low level with mass unemployment.

"2. We must plan to do this without requiring work from youth who should be in school, the aged who should be relieved if they wish it, and women who choose to make their contribution in the home, and without asking anyone to work regularly in mines, factories, transportation or offices more than 40 hours a week or 50 weeks a year, or to sacrifice the wage standards which have been set.

"3. We must plan to decentralize post-defense emergency activities as far as possible; to use to the utmost our system of modified free enterprise with its voluntary employment, its special reward for effort, imagination and improvement, its elasticity and competition; and to advance cooperatively under national and governmental leadership.

"4. We must plan to enable every human being within our boundaries to realize progressively the promise of American life in food, shelter, cloth-

(*Continued on page 42*)

3 *Money, Time and Labor Saving Features of*

UNIVERSAL CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.

For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

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THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

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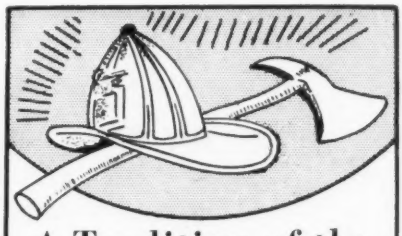
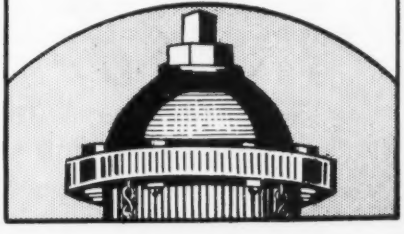
CITY _____



A Tradition of the Nations Fire Fighters

KUPFERLE FIRE HYDRANTS

Specification Sheets on Request
JOHN C. KUPFERLE FOUNDRY CO.
St. Louis



The Heart of the Empire STREEEMLINE METER

THE TIME PROVEN, BALANCED, OSCILLATING PISTON

THERE is but one moving part within the measuring chamber of the Streeemline Meter, the famous EMPIRE Balanced Piston. The perfect balance in this piston is attained by the location of the web at the vertical center of the piston. The pressure on both sides of the web is thus equalized resulting in a piston that practically glides between the top and bottom half of the chamber with minimum friction and wear.

On the bottom circumference of the oscillating piston is located a hard rubber roller bearing called the Piston Pilot that operates in a slot cut in the lower half of the measuring chamber on the inlet side. The Piston Pilot, besides acting as a guide to control the movement of the piston, eliminates all contact between the piston and the division plate. Its rolling action prevents friction, thereby providing greater sensitivity, increased accuracy at low flow rates, and assures sustained, quiet operation.

The balanced oscillating piston is only one of the many features of the EMPIRE Streeemline. This meter is the culmination of 71 years of measurement experience. Its construction embodies the indicated preferences of many water works men. It provides the unequalled performance characteristics of the time proven oscillating piston design, plus improvements and refinements resulting from present day knowledge and engineering advances.

All the features of the EMPIRE Streeemline Meter are described in detail in a new Catalog N-307. Write for a copy or arrange to have a Pittsburgh-National representative call.

PITTSBURGH EQUITABLE METER COMPANY

NEW YORK BROOKLYN DES MOINES MEMPHIS DALLAS TULSA CHICAGO BOSTON

MERCO NORDSTROM VALVE COMPANY
Main Offices, Pittsburgh, Pa.

NATIONAL METER DIVISION, Brooklyn, N. Y.

KANSAS CITY PHILADELPHIA SAN FRANCISCO LOS ANGELES SEATTLE HOUSTON COLUMBIA BUFFALO

Pittsburgh-National Meters

THE MOST COMPLETE LINE OF WATER METERS IN THE WORLD

COOK Well Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

A. D. COOK, INC.
Lawrenceburg - Indiana

COOK Deep-Well Turbine Pumps

(*Continued from page 40*)

ing, medical care, education, work, rest, home life, opportunity to advance, adventure, and the basic freedoms.

"5. We must plan to make Up-Building America the keynote of the post-defense program including both construction activities which will add to the National Estate and service activities which will end malnutrition, and increase the vitality, health, skill, productivity, knowledge and happiness of the American people, and thus add to our wealth and well-being."

Outlining the role to be taken by the Board in post-defense planning, the statement says:

"The National Resources Planning Board has been instructed by the President, (November 12, 1940) to collect, analyze and collate all constructive plans for significant public and private action in the post-defense period insofar as these have to do with the natural and human resources of the Nation. In the discharge of this responsibility the Board will serve as a clearinghouse to gather ideas and plans, to stimulate appropriate independent action by other public and private agencies, to bring together individuals who are interested in harmonizing their views, and to furnish the President and the Congress with information on these matters.

"The elected representatives of the people will, of course, make the decisions on policies and methods for meeting the problems of the post-defense period. The Congress has already provided appropriations for the inauguration of needed studies and for the preparation of post-defense plans by various agencies in the Executive branch. As these plans are matured for public discussion and appraisal the Congress will determine the ways in which they shall be put into action.

"The Board will not attempt to make plans for other agencies within their field of independent responsibility. Rather, it will seek, as in the past, to persuade other agencies to prepare plans. The Board is instructed to gather these programs on behalf of the President. The Board needs

(*Continued on page 44*)

Trade Mark MABB'S Reg. U. S. Pat. Off.

PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

MABBS RAWHIDE PACKING

on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.
Why not use it in your plant and benefit thereby?
MABBS HYDRAULIC PACKING COMPANY, *Inc. 1892*, 431 S. Dearborn St., Chicago, Ill.

Another Reason for Rensselaer Quality

Making a Brinell hardness test of metal on a Tinius Olsen Testing Machine

Tests are made daily of all Iron and Bronze used in Rensselaer Valves, Hydrants and other Products, to maintain QUALITY of the highest standards.

Buy RENSSELAER for QUALITY

Iron used is made by the "Sorbo-Mat" Process

RENSSELAER VALVE CO.

TROY, N. Y.

(*Continued from page 42*)

and requests help and cooperation of official and unofficial agencies and bodies in assembling the plans for dealing with the needs of the post-defense period."

A new water service medium is Asarco Tube-Loy made by American Smelting and Refining Company, 120 Broadway, New York, N. Y. It is available in Types A and K, completely described in bulletins of the Company. In times of priorities on certain metals, it is interesting to note that this material is reported as readily available.

Under the title, "Results of Municipal Electric Systems," the consulting engineering firm of Burns & McDonnell, of Kansas City, Mo., have just published their seventh edition (1941) of an electric rate book showing the operating records of earnings, output, rates, revenues, valuation, and other information as to the use and cost of electricity in 758 municipally-owned systems.

The volume of 428 pages is accompanied by interesting graphs and tables showing the rates and revenues, also facts pertaining to the increas-

(*Continued on page 46*)

DIFCO

Approved Ingredients of "Standard Methods" Media

Bacto-Peptone is approved in "Standard Methods of Water Analysis" of APHA-AWWA as an ingredient of culture media for use in the bacteriological examination of drinking water. Bacto-Peptone is rich in the readily available forms of nitrogen required for bacterial nutrition. In a one per solution it is sparklingly clear and has a reaction of pH 7.0.

Bacto-Beef Extract is also an approved ingredient of "Standard Methods" media. In the concentrations employed for culture media, Bacto-Beef Extract has a reaction of pH 6.8 and yields brilliantly clear solutions.

These two products may be combined with Bacto-Agar to prepare the standard nutrient agar without further adjustment or filtration of the medium.

Specify "DIFCO"
THE TRADE NAME OF THE PIONEERS
In the Research and Development of Bacto-Peptone and Dehydrated Culture Media

DIFCO LABORATORIES
INCORPORATED
DETROIT, MICHIGAN, U. S. A.

A LONG LIFE AT INITIAL CAPACITY

Naval Station, Key West, Fla. Barrett Waterworks Enamel.

FALLING capacity is no problem with Barrett-protected pipe lines. The easy flowability and fine structure of Barrett Waterworks Enamel results in an unusually smooth, mirror-like interior surface. The coefficient of flow is high.

Barrett Enamel, made from the most stable bituminous substance known for underground pipe line protection, guards against both external stresses and internal corrosion. Highly dielectric, watertight, resistant to mechanical distortion, superior Barrett coatings are more than a match for the destructive forces that cut pipe line life. Barrett Enamel meets the American Water Works Association's standard specifications 7A.5 and 7A.6 (1940).

Barrett-trained field men are available on all jobs for which Barrett Enamel is used.

FIELD SERVICE—The Barrett Waterworks Service Department and staff of Field Service men stand ready to provide a broad measure of cooperation. These services include consultation on technical details, training of crews, and job inspection.

Barrett
WATERWORKS
ENAMEL

THE BARRETT COMPANY • 40 Rector Street, New York, N. Y.

(Continued from page 44)

ing use of electricity and the decreasing cost of electricity in municipal installations.

City officials, operators, and managers of both private and municipal systems will find these operating records of much interest and value. Over half the systems in the country have lowered rates since the former 1939 edition. A majority of the cities have no bonded indebtedness on their municipal systems. The type of plant and its management are recorded. Every complete and authentic record received from municipal systems has been recorded; therefore, it is a fair, unbiased cross-section of what municipally owned systems are doing in the producing and selling of electricity from steam, diesel, and hydro plants.

The book may be obtained at a cost of $5, prepaid, from the authors, Burns & McDonnell Engineering Company, Kansas City, Mo.

Simplified welding is claimed as the outstanding feature of a new a.c. electric arc welder just announced by the Ideal Commutator Dresser Co., 1614 Park Ave., Sycamore, Ill. The design includes a reactance winding on a separate core in addition to the transformer. This reactance winding acts as a stabilizer designed to make it easy to strike an arc and hold it.

STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere

HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 50 Church Street, New York, N. Y.
General Offices and Works: West Medford Station, Boston, Mass.

HYDRO-TITE

Reg. U.S. Pat. Off.

A Symbol of Quality

A DEPENDABLE SELF - CAULKING JOINT COMPOUND

NEWS OF THE FIELD

The O.P.M. rules are changed from week to week. Readers of this JOURNAL must keep in mind that what was said six months ago about the Priorities situation has gone with the summer. From a season when it was thought that allocation procedures would apply only to a few materials, things have changed so that there is no important metal or construction material that is not under definite control or approaching such status.

As of October 1, 1941, the situation as it affects public water supply follows the lines indicated below.

Maintenance, Repair and Operation Materials: Available to public water supply plants under the terms of Order P-46. This order is reproduced in full in the text portion of this issue of the JOURNAL. The chief executive of each water plant *must* execute a typewritten copy of the form of acceptance and *must* send it to the Power Division of the O.P.M. in Washington, D. C. A duplicate copy of the acceptance form duly signed must be kept at hand in the principal office of the water department or company, subject to perusal by a representative of the O.P.M. who may call at the plant.

Project Ratings for Water Works Construction: The Office of Production Management has put into effect a type of preference rating order known as a Project Rating. This grants a priority standing to an entire project for all the materials that go into it which are on the "critical" or "sub-critical" list.

If a water works executive has need to make an extension of facilities to meet demands created by: (1) a defense industry; (2) an Army, Navy, or other military training center; (3) a defense housing project; (4) large increase in population due to defense activities; or (5) growth of population/deficiency of capacity.

An application for a project rating should be made by addressing a letter to the Director of Priorities, for the attention of the Priority Group, Washington, D. C. The letter should contain information to cover the following points:

(1) Name of the owner
(2) Location of principal office
(3) Location of proposed plant or expansion
(4) Materials to be produced
(5) Justification of the project as being necessary to defense
(6) Description of what is contemplated
(7) Type of material and equipment required in quantities, if possible, particularly of items on the critical list

(*Continued on page 2*)

(*Continued from page 1*)

(8) The estimated date of completion
(9) The estimated cost to complete
  (a) materials
  (b) total
(10) Per cent complete at present

This amounts to an engineering report or brief in support of the need. It should tell everything related to the situation. If the project is designed to serve a defense industry, training center, etc. which has a priority rating for its direct use, reference should be made to the defense project and to the rating assigned to it in the application for the water department.

It is obvious that if the authorities responsible for the creation of the increased demand upon the water department expect prompt use of the facilities which they are installing, the availability of water supply is essential to that use and the water department's need for extension material must be available as promptly as the other materials going directly into the defense project.

The statement should be mailed or delivered in person to:

Director of Priorities,
Office of Production Management,
Attention: Project Priority Group,
Washington, D. C.

The study of each application involves:

(a) A recommendation from the various commodity experts concerned with the materials that the expansion is needed and that allocation of materials to it is justified under present circumstances.
(b) Agreement with the Army and Navy Munitions Board that the proposed rating is satisfactory.
(c) Preparation of a brief by the Project Section justifying the proposed rating.
(d) Approval by the Legal Division of the O.P.M.

If approved the project rating is then issued to the water department making the request.

(*Continued on page 4*)

Thomas F. Halpin, Secretary and Sales Manager of the A. P. Smith Mfg. Co., East Orange, N. J., died at the age of 68 on August 29. He had been ill for several months.

Mr. Halpin began his long service at the A. P. Smith Mfg. Co. in 1900 as a clerk. He had served on the old Newark Board of Works, being elected in 1906. In 1931 he became Federal Jury Commissioner, serving until 1934. In 1939 he was appointed County Jury Commissioner.

He had been an active Member of the A. W. W. A. since 1901.

WHERE TUBERCULATING WATERS MUST BE TRANSPORTED

(LESS THAN 25% OF THE U. S. A.)

USE LINED CAST IRON PIPE*

THE areas of the United States where tuberculating waters materially affect the carrying capacity of pipe represent *less than one-quarter of the total area of the country.* If you are located within one of these areas, use *lined* cast iron pipe. You do *not* have to sacrifice the long life, low maintenance cost and salvage value of cast iron pipe in order to be assured of high carrying capacity throughout the life of the pipe you buy. The Cast Iron Pipe Research Association recommends *lined* cast iron pipe where tuberculating waters must be transported. Lined cast iron pipe is the only pipe that will have 100 years of useful life plus 100 years of high carrying capacity. Send for map which shows approximately 76% of the country where little or no tuberculation is to be expected. Lined cast iron pipe is made in sizes from 1¼ to 84 inches.

**Various types of linings are available to meet various conditions and preferences of users.*

CAST Q IRON

Look for the "Q-Check" Registered trade mark.

The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago, Illinois

CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(Continued from page 2)

Depending upon the nature of the project and the character of the defense work dependent upon the proposed extension of services, project ratings in the upper "A" brackets have been given to some water works projects. At the present time the project rating system is the necessary path for the water works executive to follow in arranging for extensions to his system.

Individual Items of a Water System:—not covered by the maintenance order and too small for project rating—are applied for on form PD-1, if a preferance rating is necessary to obtain them. This form can be obtained only from the O.P.M., Washington, or from one of its Field Offices. (See list on p. 6.)

This form and its use were described in the August JOURNAL in an insert section (green pages) immediately following the Abstract Section. A separate set of Forms PD-1 is required for each individual supplier from

(Continued on page 8)

Daniel Dana Jackson, Sr., retired Professor and Administrative Officer of the Dept. of Chemical Engineering at Columbia University, died September 1, at the age of 71 at his summer home at Mattituck, L. I.

Born in Gloucester, Mass., Prof. Jackson was graduated from Massachusetts Institute of Technology in 1893 and that year was employed as chemist by the Boston water works. He was a biologist for the Massachusetts State Board of Health from 1895 to 1897 and at the same time lectured at Massachusetts Institute of Technology and studied at the Harvard Graduate School.

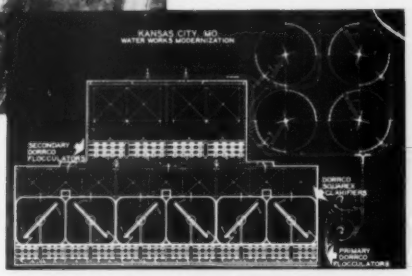
Prof. Jackson became Chief Chemist for the Brooklyn Water Supply Dept. in 1897 and remained there until 1904 when he became Director of Laboratories for the New York Dept. of Water Supply, Gas and Electricity, a position he held until 1912. From 1911 to 1913 he lectured at Columbia University on sanitary engineering and bacteriology and was Assistant Professor of Chemical Engineering there from 1913 to 1917. In 1917 and 1918 he was Associate Professor and in 1918 became head of the department. He retired in 1939.

During the World War, Prof. Jackson served on the Advisory Committee on Training Camps under the War Dept., as Dean of the School of Military Photography of the Signal Corps, and as Professor at the School of Explosives of the Ordnance Dept. He also served on the Advisory Committee of the New York Health Dept. From 1912 to 1918 he was Vice-President of the Leavitt-Jackson Engineering Company and from 1912 to 1917 he was Technical Manager of the Permutit Company.

He had been an Active Member of the A. W. W. A. and was a member, fellow or councilor of many associations and societies.

THE KANSAS CITY WATER WORKS

◀ Kansas City Water Works today. In foreground plain basins to be Dorr-equipped. In background, existing Dorr Clarifiers for presedimentation.



▲ Details of the modernization program.

Modernized with Dorr Clarifiers & Flocculators for 100-150 M.G.D. of Softening

★ Away back in 1926, we supplied Kansas City, Missouri, with 4 Dorr Clarifiers, each 200 feet in diameter, for presettling raw Missouri River water ahead of plain coagulation and filtration.

Now in 1941, Kansas City is modernizing—going to softening, too—installing flexible Dorr units for continuous flocculation and sedimentation in the existing plain basins. All this at a small fraction of the cost of a new installation with new tanks.

Dorrco Squarex Clarifiers and Flocculators are ideal running mates in old plants as well as in new ones. Square sedimentation units, installed thus in multiple, mean inexpensive unit tank construction—a pleasing compact layout—and a minimum of interconnecting pipe lines and channels.

● *Water works served now by plain basins can profit from a Dorr modernization program. Size and shape of existing tanks are no handicaps to Dorr Clarifiers and Flocculators.*

Primary Flocculation—6 units of Dorrco Flocculators (each 165′ × 55′ × 18′)

Secondary Flocculation — 2 units of Dorrco Flocculators (each 257′ × 54′ × 17′)

Secondary Sedimentation—6 Dorrco Squarex Clarifiers (155′ square × 15′4″ side depth)

Cons. Engrs: Black & Veatch
Burns & McDonnell

FACTS ON THIS PROJECT

Type: Presedimentation followed by softening.
Capacity: 100 M.G.D., at present; 150 M.G.D. in future.
Source of Raw Water: Missouri River
Raw Water Turbidity: 200-10,000 P.P.M.
Raw Water Hardness: 175-300 P.P.M.
Treated Water Hardness: 90 P.P.M.
Reagents: Lime, alum, iron, chlorine, CO_2.

The DORR COMPANY Inc.
ENGINEERS · 570 LEXINGTON AVE. · NEW YORK
ATLANTA TORONTO CHICAGO DENVER LOS ANGELES

(*Continued from page 4*)

whom material is to be purchased, but several items from one supplier may be listed on one set of Forms PD-1.

Quarterly Inventory Reports to the O.P.M. are to be required from every water department operating in accordance with Order P-46. Read it carefully and be prepared to furnish reports when called upon by the O.P.M.

Office of Production Management
Priorities Division Field Offices

Following is a list of the Priorities Division Field Offices which have been established to date by the Office of Production Management. Communications should be addressed to the District Manager (by name and title), Priorities Field Service, Office of Production Management. For example a communication to the Atlanta, Ga. office should be addressed:

Mr. John B. Reeves, District Manager,
Priorities Field Service,
Office of Production Management,
107 Marietta Street,
Atlanta, Ga.

Atlanta, Ga.
John B. Reeves
104 Marietta St.

Baltimore, Md.
Theodore M. Chandlee
Baltimore Trust Bldg.

Boston, Mass.
William P. Homans
30 Pearl St.

Buffalo, N. Y.
Paul R. Smith
M & T Bank Bldg.

Charlotte, N. C.
J. E. MacDougall
Liberty Life Bldg.

Chicago, Ill.
Warren G. Bailey
164 W. Jackson Blvd.

Cincinnati, Ohio
Bruce W. Burroughs
34 E. Fourth St.

Cleveland, Ohio
William T. Walker
E. 6th St. & Superior Ave.

Dallas, Tex.
James B. Crockett
Wood & Akard Sts.

Denver, Colo.
Virgil L. Board
U. S. Nat'l Bank Bldg.

Detroit, Mich.
Walter Hall
160 Fort St., West

Houston, Tex.
George L. Noble, Jr.
Fed. Res. Bank Bldg.

Indianapolis, Ind.
Albert O. Evans
Circle Tower Bldg.

Jacksonville, Fla.
George H. Andrews
Hildebrandt Bldg.

Kansas City, Mo.
Clifford H. Carr
Fed. Res. Bank Bldg.

Los Angeles, Calif.
G. Howard Hutchins
1151 S. Broadway

Minneapolis, Minn.
Willard F. Kiesner
Rand Tower Bldg.

New York, N. Y.
John D. Pollock
25 Broad St.

Philadelphia, Pa.
Frederick W. Slack
925 Chestnut St.

Pittsburgh, Pa.
Charles F. Cruciger
Grant St. & Ogle Way

Portland, Ore.
J. Fred Bergesch
Bedell Bldg.

Richmond, Va.
Fred P. Wilmer
Fed. Res. Bank Bldg.

St. Louis, Mo.
Louis E. Crandall
411 Locust St.

Salt Lake City, Utah
Ralph E. Bristol
Utah Oil Bldg.

San Antonio, Tex.
Carl L. Pool
415 W. French Place

San Francisco, Calif.
Andrew L. Kerr
400 Sansome St.

Seattle, Wash.
William D. Shannon
957 Stuart Bldg.

(10 more offices are in process of organization.)

(*Continued on page 8*)

does your defense program include plans for an ample supply of water?

Has tuberculation and corrosion crippled the carrying capacity and safety of your water mains? Can your mains meet the increasing demands of busy plants producing materials for national defense—and still deliver the "all out" so essential in emergencies?

If not, now is the time to build a factor of safety into your water system—and it can be done effectively, economically, speedily, and immediately. Effectively because the carrying capacity of your mains will be permanently restored; economically because no new mains are required; and immediately because *no priorities are needed.*

The method is "Centrilining". The only materials needed are sand, cement and water, for this process consists of cleaning the old main thoroughly to remove tubercles and incrustations, then applying a rich, dense lining of cement mortar by centrifugal force, mechanically trowelled to a smooth finish. All work is done in situ, thereby eliminating costly and troublesome excavation.

If you are interested in a smooth, clean pipe line having a permanently high carrying capacity and lower pumping costs, plus lasting protection against corrosion and tuberculation at a fraction of the cost of a new pipe line—investigate the Centriline Process.

CENTRILINE CORPORATION

140 CEDAR STREET, NEW YORK, N. Y.

OLDEST
FASTEST
CHEAPEST
BEST

Send for this booklet

Photograph by Galloway

10-CC-1

(*Continued from page 6*)

Irene M. Melbo

In charge of the Bellingham, Wash., new purification plant is Miss Irene Melbo. When last April Glen W. Campbell, Captain, C.W.S., was called to extended active duty to serve as Chemical Warfare Liaison Officer, Medical Field Service School, Carlisle Barracks, Pa., the Bellingham Water Commission placed Miss Melbo in charge of the plant. Miss Melbo received her schooling at the Western Washington College of Education, Bellingham, Wash., and had 2½ years' practical laboratory experience before elevation to her present position. She had been serving as Laboratory Assistant at Bellingham.

The City of Bellingham has just completed a $750,000 improvement to its water supply. This consisted of driving a 7,000-foot tunnel to Lake Whatcom, the constructionof a 1,250-foot continuous wood stave intake pipe out into the lake, the construction of a new purification plant and the construction of a new industrial supply main from the purification plant to the waterfront, a distance of about 3 mi. The new plant is delivering about 35 m.g.d.

(*Continued on page 10*)

Clarence H. Kennedy, Vice-President in Charge of Sales of the Kennedy Valve Mfg. Co., Elmira, N. Y., died on July 21 at Elmira.

Born in Brooklyn, N. Y., in 1890, he was graduated with the degree of Mechanical Engineer from Cornell University in 1912. His entire business career was spent with the Kennedy Valve Mfg. Co. which was founded by his father in 1877. He worked in various factory departments before he became Manager of the New York Branch and later Sales Manager of the Company. Since 1929 he had been Vice-President in Charge of Sales. In 1933 he was "drafted" by President Roosevelt to work with other industrial leaders in re-employment campaigns held in connection with the national recovery drive.

MODERN ELEVATED WATER STORAGE...

by PITTSBURGH • DES MOINES

Master Builders of elevated steel tanks for the American municipality—designed, fabricated and erected in all types from 50,000 to 5,000,000 gallons of capacity. Write for our completely descriptive 20-page Bulletin No. 101.

PITTSBURGH • DES MOINES STEEL CO

ITTSBURGH, PA., 3424 NEVILLE ISLAND—DES MOINES, IOWA, 925 TUTTLE STREE

NEW YORK, ROOM 921, 270 BROADWAY . . . CHICAGO, 1228 FIRST NATIONAL BANK BUILDING
DALLAS, 1229 PRAETORIAN BUILDING . . . SAN FRANCISCO, 631 RIALTO BUILDING
SEATTLE, 1132 EIGHTH AVENUE, SOUTH

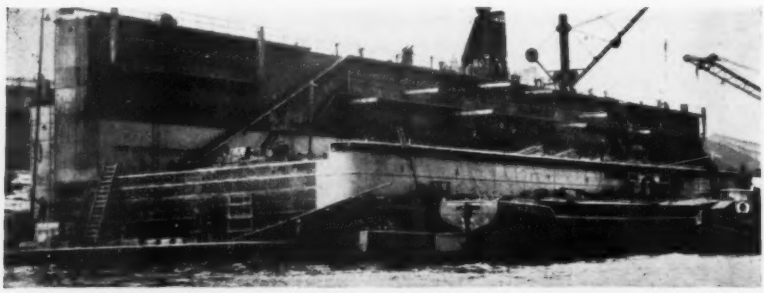
(*Continued from page 8*)

J. D. Richetta, Senior Sanitary Engineer with the Bureau of Sanitary Engineering of the Indiana State Board of Health, has left that position to engage in the designing of water and sewerage systems for an army cantonment which is tentatively planned for Morganfield, Ky. Mr. Richetta had given notable service with the Indiana Bureau of Sanitary Engineering for the past five years. He has been active in A. W. W. A. Indiana Section affairs and in the promotion of short schools in Indiana.

Kaarlo W. Nasi, Public Health Engineer for the Territorial Dept. of Health, Juneau, Alaska, has taken a year's leave of absence to do graduate work at Harvard University.

John C. Pritchard, Major, Q.M.C., is now serving as Executive to Lieutenant Colonel Underwood, Constructing Quartermaster in the Twin City Ordnance Plant, with headquarters at St. Paul, Minn. Before he was assigned to the 30-million dollar ordnance plant construction project, Major Pritchard was on duty for a short time in the Zone Constructing Quartermaster Office in Omaha, Neb. Previously Major Pritchard has been a

(*Continued on page 12*)



no corrosion after 46 years!

One of the greatest records of protection against corrosion in recent years is found in the application of Bitumastic Enamel to the interior of the Pontoon Dock of the Smith's Dock Company, North Shields, England (shown above).

Forty-six years after the coating was applied, the dock was broken up because of obsolescence and the coating and steel were found to be in excellent condition!

It is not surprising that Bitumastic Enamel is standard in the specifications of engineers for pipe lines, penstocks and other water works projects.

Send for booklet—"Bitumastic Protection for Water & Sewer Pipe Lines", describing many interesting coating jobs.

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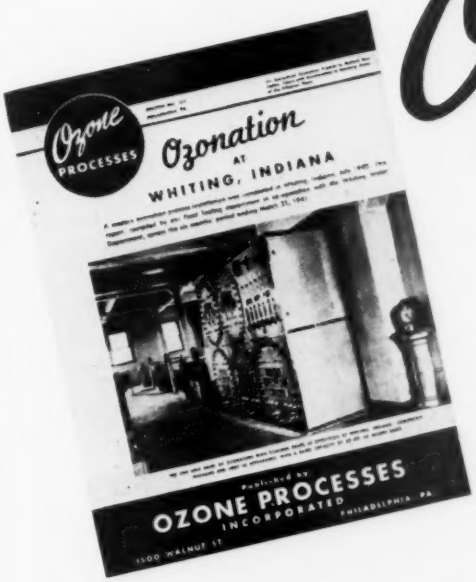

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Ozone Processes, Incorporated, is an operating member of a well-established and soundly financed group, which has been serving American industry for over 60 years. The management is experienced and keenly aware of its responsibility to the Water Works Industry. This explains the thorough research and skilled engineering supporting every move we make in this field.

(Continued from page 10)

Consulting Engineer in St. Louis, Mo., and has served as Director of Public Utilities for that city.

Thad M. Erwin, Water Sales Agent of the Los Angeles Dept. of Water and Power, retired on August 31 with the following resolution by the Los Angeles Board of Water and Power Commissioners in his pocket:

"WHEREAS, Mr. Thad M. Erwin entered the service of the Department of Water and Power of The City of Los Angeles on January 13, 1913, and for the past seventeen years has been employed as Water Sales Agent of this Department, under the Board of Public Service Commissioners and subsequently the Board of Water and Power Commissioners; and

"WHEREAS, During these more than twenty-eight years, Mr. Erwin has brought much credit to this Department through the establishment and maintenance of cordial relationships with its water consumers, and has lent his broad experience and wise guidance toward the formulation of regulations and customs governing water service installations and extensions which have become nationally recognized; and

(Continued on page 14)

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Rusta Restor is the only positive method of preventing rust in all types of steel tanks and riser pipes (the electrical method)
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CONTENTS
WHAT DOES IT MEAN?
• AVAILABLE CHLORINE
This term is generally used for stating the strength of compounds used in lieu of chlorine gas, specifically the hypochlorites or materials containing the hypochlorite radical. Confusion often arises as a result of calculators being unable to find the indicated chlorine percentage when they consider the molecular composition without also taking into account the chemistry of reaction of the hypochlorites.
Simply stated, "available chlorine" is a measurement of the oxidizing power expressed in terms of an equivalent quantity of chlorine.
It originated from an old method of chlorinated lime strength determination before the days of titration procedure. Gas evolution methods were largely used and, in the case of chlorinated lime, it was acidified and the volume of evolved chlorine gas measured and expressed as "percent chlorine available."
If a hypochlorite is acidified with hydrochloric acid, each hypochlorite ion (OCl) releases 2 chlorine atoms from the acid. The quantity of chlorine released is, therefore, a function of the OCl ions present, and the strengths are calculated from the quantity of these ions, rather than from the chlorine bound up in the molecular structure.
Thus, calcium hypochlorite ($Ca(OCl)_2$) has an available chlorine equivalent of 2 chlorine atoms for each OCl ion, or a total of 4 chlorine atoms for each molecule.
Its "available chlorine" $= \frac{4Cl(100)}{Ca(OCl)_2} = \frac{4(35.46)(100)}{142.92} = 99.24\%$
And 100 pounds of calcium hypochlorite do the disinfecting or oxidizing work of 99.24 pounds of chlorine gas.
Likewise, Perchloron, containing "not less than 70% calcium hypochlorite by weight" also may be stated to have "available chlorine not less than 69.47% by weight." For 99.24% of 70% is 69.47%.
For all practical purposes, therefore, 100 pounds of Perchloron are equal in work value to 70 pounds of chlorine.

◀ This is a valuable new handbook on Perchloron, from which is taken this excerpt on available chlorine. Write us for your *FREE* copy.

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NEW YORK CHICAGO ST. LOUIS PITTSBURGH WYANDOTTE TACOMA

(*Continued from page 12*)

"WHEREAS, Mr. Erwin has gained the friendship and admiration of the entire Department and of all officials and executives in the service of The City of Los Angeles for his great ability, fine leadership, gracious personality, and loyal performance of all duties assigned to him; and

"WHEREAS, Mr. Erwin, having reached normal retirement age, will retire from active duty on August 31, 1941:

"Now, therefore, be it *Resolved*, That this Board take appropriate recognition of the long and brilliant service of Mr. Erwin, expressing its appreciation to him in behalf of the officials, executives, and employees of the Department of Water and Power, and extending to him its sincere wish that he may continue to enjoy for many years to come the fullest measure of health and happiness; and

"Be it further *Resolved*, That the Secretary be instructed to have this resolution engrossed on parchment and presented to Mr. Erwin as a lasting recognition of his long and splendid service.

Representatives from some thirty water districts in Westchester County, New York, met August 20 to adopt by-laws and elect the permanent officers of the newly-formed group known as the Westchester Water Works Conference. It is expected that the closer association within the County will be of benefit to the men and to the districts which they serve.

About seventy water works men have enrolled in the "Three-W Conference," including delegates from both the rural and urban sections of the county. Their districts serve a population estimated at 560,000 persons. In terms of water, the various systems combined have an average distribution of nearly 50 m.g.d.

Enrollment is open to all those, within Westchester, who are, "actively engaged in water works operation." One of the interesting stipulations in the by-laws is that no membership dues shall be collected.

Officers for the ensuing term are: Eugene T. Cranch, New Rochelle, Chairman; R. M. McLaughlin, County Health Department, White Plains, Secretary-Treasurer; and six Directors—Frank Naylor, Peekskill; Andrew S. Grantham, Greenburgh; Frank Kelley, Valhalla; Sidney Hickock, Catonah; James F. Conlan, Scarsdale; H. T. Hotchkiss, Larchmont. Others who actively participated in the organization of the

(*Continued on page 16*)

Leon A. Goodale, Superintendent, Bureau of Water, Worcester, Mass., died on Sept. 17 at the age of 65. He served as Engineer of Reservoirs for Worcester from 1907 to 1928 and had charge of the city's construction of its Pine Hill Dam and Reservoir. He became Water Commissioner and Registrar in 1929 and in 1939 became Superintendent. He was an Active Member of the A. W. W. A.

Here's Proof from Calgon Users . . .

Articles in the technical press report the excellent results obtained with Calgon

RED WATER STOPPED by simple treatment

Chappaqua, N.Y., supplants lime with Calgon and complaints stop.

This paper describes how "red water" flowing from the faucets of house services in Chappaqua has been eliminated by the use of Calgon at the treatment plant. The staining of tubs and bowls has stopped, and this desirable result has been obtained even in dead ends.

From American City, June 1941. Page 20.

PREVENTING CORROSION ***with lime and Calgon***

At this plant, lime is added to increase the pH from 5.2 to 7.2–7.6. Until Calgon was introduced into the feeding system the lime plant of the Freeport, Long Island, Water Department was shut down on an average of every five weeks to clear out the hard lime deposit. After Calgon was used, there was such an improvement that the plant has now been working without interruption since March 25, 1940.

From Public Works, July 1941, Page 13. "My experience with Lime and Calgon in the Prevention of Corrosion" by A. C. Southard.

STABILIZING WATER ***after lime treatment***

This paper is a general discussion of the new lime-zeolite softening plant which has been built to treat the domestically used portion of the water brought in through the Colorado River Aqueduct to Los Angeles. It describes the use of Calgon in stabilizing the water following lime treatment and before passage through the zeolite.

From Western City, July 1941. "The New Water Purification Plant of the Metropolitan Water District of Southern California."

PREVENTING SCALE ***in hot water heaters***

At the new Wichita, Kansas, plant, much difficulty was experienced with rapid scale formation in hot water heaters. Mr. Rogers explains in detail the tests which were made with Calgon and the good results it has given in preventing heaters from clogging.

From Journal American Water Works Assn. July 1941, Page 1233. "Operation Problems in the New Wichita Water System" by M. E. Rogers, Supt. of Production.

THESE four articles—all in current magazines—show the intense interest in Calgon* . . . and its effectiveness in solving four major water problems: (1) It controls corrosion, (2) prevents precipitation of dissolved iron, (3) stabilizes water after lime or lime soda softening, (4) prevents scale formation from high-bicarbonate waters—AND DOES THESE THINGS AT SURPRISINGLY LOW COST.

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*Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products.

calgon, inc.
300 ROSS ST. PITTSBURGH, PA.

(Continued from page 14)

Conference were Dan C. Nolan, Tarrytown; James C. Harding, Mt. Kisco, and A. G. Jewell, Mt. Vernon.

An interesting pipe cleaning operation is described in the September, 1941, Ohio Section (of A. W. W. A.) News: At the Athens State Hospital, Tom Driskell found "the hot water lines, a 4-inch and a 6-inch, badly incrusted with rust deposits. The 6-inch line was almost completely closed and the 4-inch pipe had about a 1-inch hole through it. He set up a pump and pumped an inhibited acid through these lines, 400 feet in all, and completely cleaned the rust deposits from them in a few hours time. His acid solution consisted of commercial hydrochloric acid to which was added aniline oil in the ratio of 100 parts acid to 2 parts aniline. There are probably many places where this inhibited acid has an application in the water works plant. It has the peculiar property of removing rust and scale without dissolving iron.

"Tom says if you ever try anything like this that it is easier to pump acid with a plunger pump. A centrifugal which he first tried became air bound due to the evolution of gas by the action of the acid on the deposits n the pipe."

(Continued on page 18)

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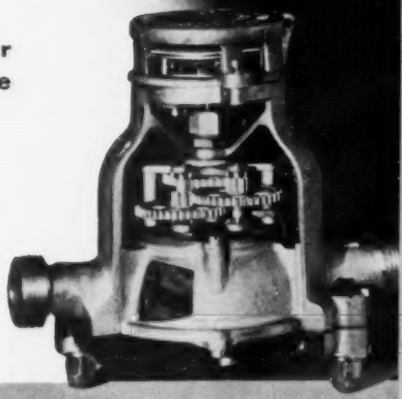

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SAN FRANCISCO — LOS ANGELES

(Continued from page 16)

Priorities assistance for the construction of 200,000 privately financed defense housing units has been inaugurated by an order signed September 12 by Donald M. Nelson, Director of Priorities, Office of Production Management. Project ratings will be given such construction in Defense Housing Critical Areas so that scarce building materials (which are on the Defense Housing Critical List) can be secured.

To obtain a preference rating for a defense housing project, the private builder must file an application with the local office of the Federal Housing Administration. The Director of Priorities is making this use of the facilities of the F.H.A. as a ready means of immediate assistance. This special service of the F.H.A. is completely divorced from and has no connection with its underwriting activities as a mortgage insurance agency.

To qualify for the priority assistance extended under the new plan, construction must be confined to family units of a value not in excess of $6,000, if for sale, or for which the monthly shelter rental does not exceed $50.

No application for aid will be considered by the priorities officials until it has been demonstrated that the homes involved are designed for and are readily available to defense workers, at prices within their reach,

(Continued on page 20)

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One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

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NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

(*Continued from page 18*)

at locations convenient to their employment, and conform to minimum standards as developed by the Defense Housing Co-ordinator. It must also be demonstrated that such housing is being, or will be, built in such a way as to use minimum quantities of scarce materials.

Those interested in the complete details can obtain Release PM 1192 of the O.P.M. Division of Priorities. Reproduced immediately below is the description of materials relating to plumbing and gas distribution systems—only a part of the Defense Housing Critical List contained in Release PM 1192. Also given below is the list of the Defense Housing Critical Areas from the same release. (See pages 26 and 28.)

Plumbing and Gas Distribution Systems—to include only:

1. Cast or stamped ferrous metal, enameled and vitreous ware plumbing fixtures, the latter wherever practicable.
2. Fixture Fittings and Trimmings—Base metal limited to ferrous metal, yellow brass and zinc die castings with plating of flashed copper and nickel or unplated.
3. Drainage and Venting Systems—to include only:
   a. Cast iron pipe and fittings.
   b. Galvanized steel pipe, wrought iron pipe and malleable fittings generally non-metallic coated.

(*Continued on page 22*)

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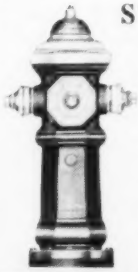

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If a leak of very small magnitude is reported or detected, the maintenance crew is put to work at once repairing it; while on the other hand, a large industrial meter, through which a very large volume of water is consumed, might be allowed to run an under-registration of fifteen percent to twenty percent for quite a long period of time. From a standpoint of practical operation, what difference is there between a leak on a main in the street and the waste of water leaking through a consumer's meter from which no revenue is derived?

The un-accounted-for-water in Nashville has been reduced some ten or fifteen percent in recent years; and the writer is of the opinion that this result is attributable, in a large measure, to the intensive program of testing and repairing our large meters in the two-inch, three-inch, four-inch and six-inch sizes."

Robert L. Lawrence

Superintendent & Chief Engineer
NASHVILLE, TENN. WATERWORKS DEPT.

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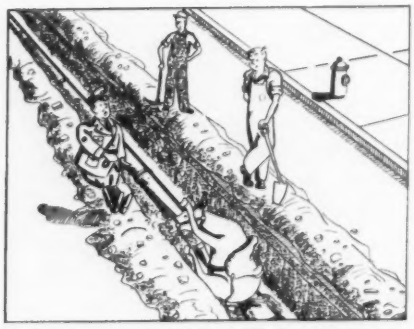
Neptune Meters, Ltd., 345 Sorauren Avenue, Toronto, Canada.

(*Continued from page 20*)

c. Ferrous metal and brass tubing traps, clean-outs and connections for fixtures (Brass limited to minimum necessary).

4. Water Distribution Systems—to include only:
   a. Galvanized steel or wrought iron pipe and malleable fittings, or cement lined ferrous pipe and fittings—lead wherever practicable, inside buildings only.
   b. Valves—iron and brass (brass limited to minimum necessary and used for seats only wherever practicable).
5. Water Heaters (storage type) and Hot Water Storage Tanks—made only of:
   a. Galvanized sheet—only where local conditions necessitate.
   b. Black steel, painted.
   c. Coated steel (Enamel or glass lined).
   d. Brass valves, connections and controls for water heaters.
   e. Copper coils for storage type hot water generators and heat exchangers—multi-family systems only.
6. Water Softeners for multi-family dwellings only, to have painted steel exteriors, interiors as for water heaters, etc.

(*Continued on page 26*)



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(*Continued from page 22*)

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- Birmingham
- Childersburg-Sylcauga-Talladega
- Gadsden
- Mobile
- Montgomery
- Muscle Shoals
- Phenix City
- Selma

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- Litchfield Park
- Tucson

Arkansas
- Hope
- Little Rock-Jacksonville
- Ft. Smith

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- Bakersfield
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- Monterey
- Oceanside-Fall Brook
- San Diego
- San Francisco & East Bay Cities
- San Luis Obispo
- San Miguel-Paso Robles
- Stockton
- Vallejo

Colorado
- Denver

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- Bridgeport
- Hartford
- Meriden
- Middletown
- New Britain-Bristol
- New Haven
- New London
- Stamford
- Waterbury

Delaware
- Wilmington

District of Columbia
- Washington

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- Jacksonville
- Key West
- Opa Locka
- Orlando
- Panama City
- Pensacola
- Starke
- Tallahassee
- Tampa
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- Rantoul
- Rockford
- Savanna

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- Charleston-Jefferson-Lousville, Ky.
- Connersville
- Ft. Wayne
- Gary Hammond
- Indianapolis
- La Fayette
- La Porte-Kingsbury
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- Council Bluffs
- Des Moines

Kansas
- Junction City
- Kansas City
- Parsons
- Witchita

Kentucky
- Louisville-Charlestown

Louisiana
- Alexandria
- Baton Rouge
- Lake Charles
- Leesville-DeRidder
- New Orleans
- Shreveport

Maine
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- Bath
- Portland

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- Annapolis
- Baltimore
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- Pittsfield
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- Worcester

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- Battle Creek
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(*Continued on page 28*)

Another Reason for Rensselaer Quality

Making a Tensile test and at the same time determining the yield point of metal, by using an Extensometer on a Riehle Testing Machine.

Tests are made daily to maintain "quality" of highest standards.

Buy RENSSELAER for QUALITY

Iron used is made by the "Sorbo-Mat" Process

RENSSELAER VALVE CO.

TROY, N. Y.

(Continued from page 26)

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- Bound Brook-Perth Amboy
- Dover
- Newark-Kearny-Elizabeth
- New Brunswick
- Patterson-Passaic
- Trenton

New Mexico
- Gallup

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- Binghamton
- Brooklyn-Long Island City
- Buffalo-Niagara Falls
- Dunkirk
- Elmira
- Greenport
- Massena
- Poughkeepsie
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- Sidney
- Syracuse
- Troy-Watervliet-Albany
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- Watertown

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- Fayetteville
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- Wilmington

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- Toledo
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- Lawton
- Oklahoma City
- Tulsa

Oregon
- Astoria
- Hermiston
- Pendleton
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- Beaver County
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- Corry
- Ellwood City
- Erie
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- Johnstown
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- Norristown-Bridgeport
- Philadelphia-Camden-Chester
- Pittsburgh-New Kingston
- Pottstown
- Sharon
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- Brackettville
- Brady
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- Corpus Christi
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- Denison-Sherman
- Dumas
- El Paso
- Freeport
- Galveston
- Harlingen
- Houston
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- Mineral Wells
- Palacios
- San Angelo
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- Victoria
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- Ketchikan
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- Sitka

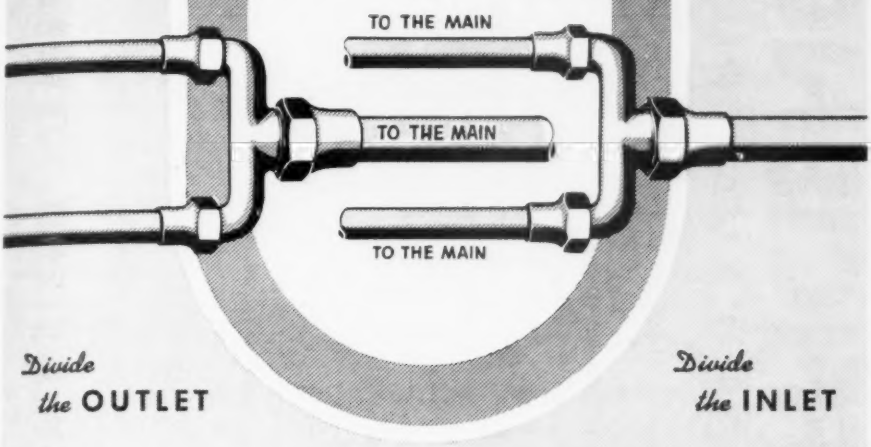
Hawaii
- Honolulu

Virgin Islands
- Charlotte-Amolie

Puerto Rico
- Aquadilla
- San Juan

(Continued on page 31)

HAYS "U" CONNECTIONS



VISITORS at the Toronto Convention were amazed with the variety of branch connections that Hays makes for lead pipe, lead flange, iron pipe and copper services. There are more and more applications for these multiple connections. This is just another indication of the complete service that Hays makes available to water works departments everywhere. There are more than 100 patterns listed under "U" and "Y" Branch connections in the new Hays catalog. Make sure you have this new Hays catalog at your fingertips by writing today for a copy.

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HAYS Water Works PRODUCTS

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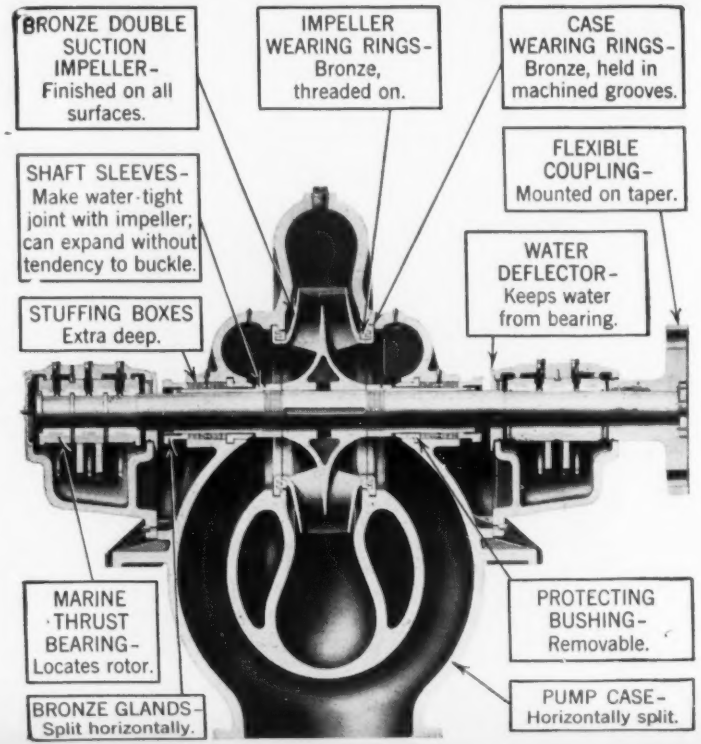
SUSTAINED EFFICIENCY
OF DE LAVAL PUMPS


BRONZE DOUBLE SUCTION IMPELLER- Finished on all surfaces.
IMPELLER WEARING RINGS- Bronze, threaded on.
CASE WEARING RINGS- Bronze, held in machined grooves.
SHAFT SLEEVES- Make water-tight joint with impeller; can expand without tendency to buckle.
FLEXIBLE COUPLING- Mounted on taper.
WATER DEFLECTOR- Keeps water from bearing.
STUFFING BOXES Extra deep.
MARINE THRUST BEARING- Locates rotor.
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PUMP CASE- Horizontally split.

is due to proper hydraulic design, which avoids cavitation and pitting, and particularly to renewable LABYRINTH WEARING RINGS, which protect casing and impeller from erosion and reduce leakage from discharge to suction.

With De Laval LABYRINTH RINGS there is only about one-third as much leakage as between plain rings having the same radial clearance, or for the same initial efficiency DeLaval pumps can have greater clearances than can pumps with flat rings. Because of the reduced leakage there is less erosion of De Laval rings than of flat rings and efficiency is better sustained. De Laval pumps which have been in continuous service for many years without renewal of parts still equal their original efficiencies, as demonstrated by numerous tests.

All parts of DeLaval pumps are interchangeable on a limit gage basis and renewals ordered by number require no fitting.

State your pumping conditions and ask for Publication P-3222.

DE LAVAL STEAM TURBINE CO.
TRENTON, N. J.

(Continued from page 28)

Report of the New York Section Meeting

The Fall Meeting of the New York Section was held at the Hotel Queensbury in Glens Falls, N. Y., on September 11 and 12.

Of particular interest to the membership was the discussion on priorities for water works materials and the effect of the defense program upon water works activities. Harry E. Jordan, Secretary of the A. W. W. A., described the activities of the A. W. W. A. Committee on Defense. Robert M. Colt, Director-Secretary of the Gloversville National Defense Council, explained in detail the organization of the Gloversville National Defense Council which is comprised of 42 local organizations and has founded an energetic and widely functioning organization for all aspects of defense. There was also a discussion of the New York State mutual aid plan for water service.

Ernest L. H. Meyer, Supt. of the Glens Falls Water Dept., described a "Dam Built on Sand." Morrell Vrooman, Consulting Civil Engineer of Gloversville, outlined the construction and features of the new Gloversville

(Continued on page 32)

DE LAVAL STEAM TURBINE CO.
TRENTON, N. J.
Horizontally split.
BRONZE GLANDS—
Split horizontally.

American Water Works Association
62nd Annual Convention
Chicago - - June 21-25, 1942

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BY WRITING DIRECTLY TO CHICAGO TO:

The Stevens Hotel

THE HEADQUARTERS HOTEL WHERE ALL
MEETINGS AND EXHIBITS WILL BE HELD.

Rates, fixed by the hotel management
for the period of the convention, are:

Single room, per day	$3.00, $3.50, $4.00, $4.50
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Suite, per day	$10.00 and up

FOR BEST RESERVATIONS, WRITE NOW

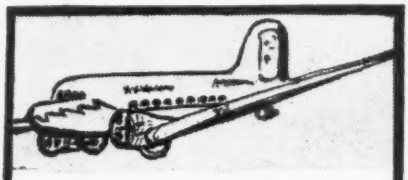
(Continued from page 31)

Filtration Plant. The development of a billing procedure for a group of small plants was related by W. H. Ogden, Vice-President of the New York Water Service Corp., Glen Cove, N. Y. Mr. Ogden made available to those present copies of meter sheets, typical bill forms and other printed material.

Of special interest was the discussion and round table led by Frank E. Densler, Executive Director of the Public Service Commission of the State of New York. The new law affecting water works operators was reviewed by Mr. Densler, and it is urged that all members carefully investigate all phases of this new law which entitles all water works employees to participate in the Civil Service. R. G. Yaxley, Supt. at Waterford, N. Y., lead a round table on experiences and R. K. Patterson, Johns-Manville, New York, gave an illustrated talk on "The Design and Construction of a Modern Water Collection and Transmission System."

A Committee report on group meetings was given by William H. Clark, Chairman of the Committee and Superintendent of Water at Avon, N. Y., and John M. Diven, Chairman of the Membership Committee, reported that, through the various activities of his Committee,

(Continued on page 34)



On Guard

The municipality or private plant protected by Kupferle Fire Hydrants have on guard sentinels of precision manufacture with a record of more than a half century of unfailing performance.

Specification Sheets on request.

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FOUNDRY COMPANY
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KUPFERLE
FIRE HYDRANTS

FILTER SAND

99 Per Cent Pure Silica
Washed, dried and manufactured to your specifications

Write for Prices on Bulk, Carload or Bags

Dawes Silica Mining Co.
Thomasville, Georgia

AMERICA'S MOST AMAZING PUMP
PEERLESS HI-LIFT

For deep wells 4" or larger
500 to 3500 gallons per hour

ALSO AVAILABLE: TURBINE & PROPELLER TYPES—capacities up to 100,000 g.p.m.
Ask for Literature

PEERLESS PUMP DIV. - Food Machinery Corp.

Factories: Los Angeles, San Jose
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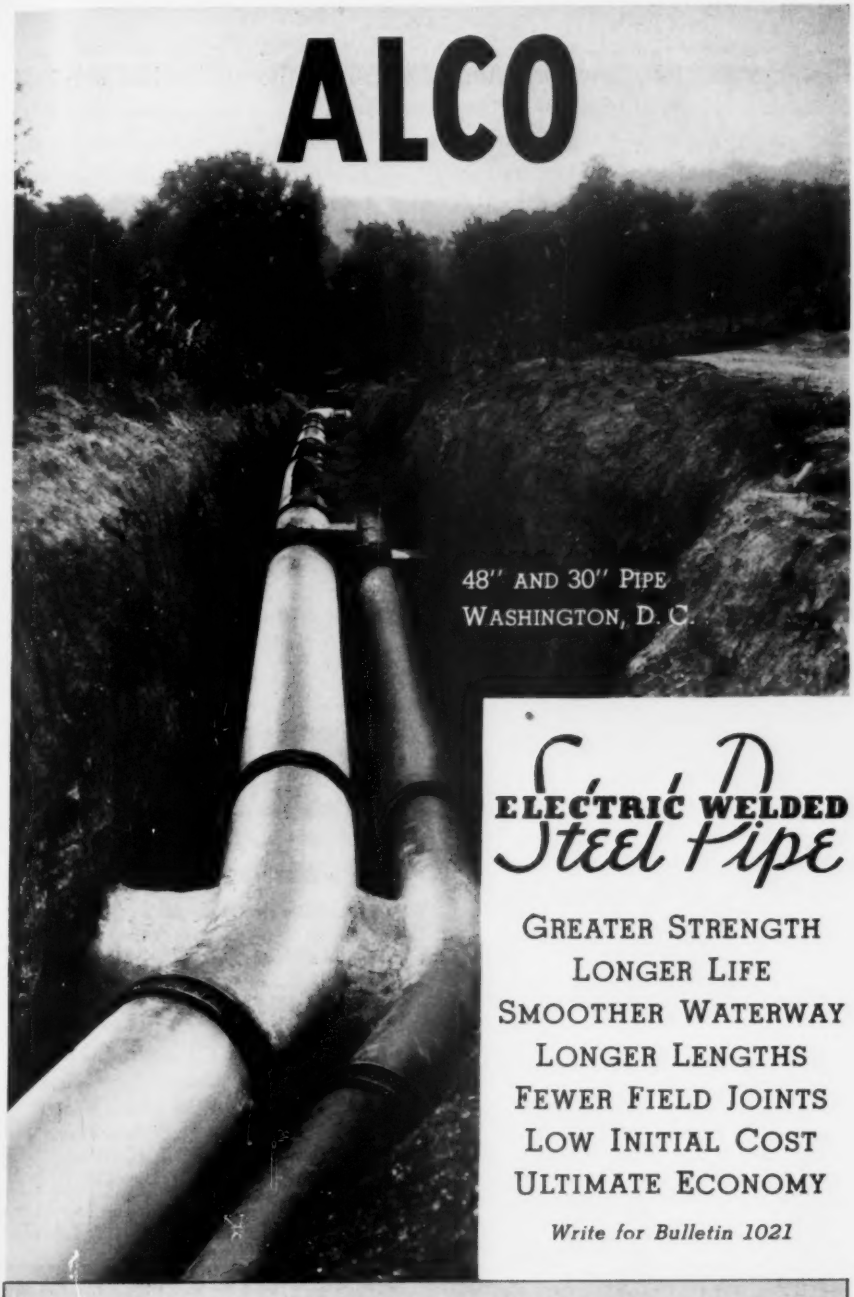

ELECTRIC WELDED
Steel Pipe

GREATER STRENGTH
LONGER LIFE
SMOOTHER WATERWAY
LONGER LENGTHS
FEWER FIELD JOINTS
LOW INITIAL COST
ULTIMATE ECONOMY

Write for Bulletin 1021

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(*Continued from page 32*)

combined with the Group Meetings Committee, the section had obtained an additional enrollment of 37 new members. It is urged that all of us give every possible aid in increasing the membership of our New York Section. Mr. Diven will extend every possible co-operation in this matter.

The following appointments were made to the Fuller Memorial Award Committee, with a request for a report at the December Meeting: *Chairman*—George Carpenter, Ithaca, N. Y.; *Committee*—Wallace T. Miller, Ossining, N. Y.; H. H. Wagenhals, State Health Dept., Syracuse, N. Y.; Robert W. Austin, New York State Public Service Comm., Albany, N. Y.; William H. Ogden, Glen Cove, N. Y.

A committee was appointed, as follows, to report on the "Standards of Purification Plant Operation": *Chairman*—James Caird, Troy, N. Y.; *Committee*—Charles F. Jost, New York, N. Y.; R. Gordon Yaxley, Waterford, N. Y.; H. C. Chandler, Albany, N. Y.; and Allan H. Rogers, Garden City, N. Y.

The meeting was followed by a clam bake, held at "The Antlers" at Lake George, on Friday afternoon.

The particular thanks of the Association are due for the fine enter-

(*Continued on page 36*)

PREPARE NOW
FOR WINTER
EMERGENCIES

STOCK UP WITH IMPROVED
DOUBLEX SIMPLEX
SPLIT SLEEVES

When Jack Frost starts playing around, you will need some of these improved sleeves for quick, economical, effective repair of broken mains. Keep several of different sizes on hand and avoid costly delays during cold weather. On the market for 12 years and many thousands in use. Order Now!

AMERICAN CAST IRON PIPE CO.
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WATER REFINING
EQUIPMENT HEADQUARTERS
INDUSTRIAL—PROCESS
RAILROAD—MUNICIPAL—HOUSEHOLD

FILTERS Of All Types *and* Capacities . . . Gravity . . . Pressure
SOFTENING SYSTEMS
All Types *and* Capacities—Zeolites (*synthetic and natural*) and Lime and Soda
CHEMICAL FEEDERS (wet or dry)
Acids . . . Hypochlorites . . . Alkalies
EQUIPMENT FOR REMOVAL
Of Iron . . . Taste . . . Odors . . . Colors . . . Suspended Matter
SWIMMING POOL EQUIPMENT
AERATORS · DE-GASIFIERS
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The AMERICAN WATER
SOFTENER COMPANY
WATER REFINING EQUIPMENT HEADQUARTERS
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Lehigh Ave. & 4th St., Phila., Pa.

We use **A FEW BILLION GALLONS OF WATER OURSELVES**

60th ANNIVERSARY 1881 • 1941

As you will note by the little "Anchor" seal, this is Solvay's 60th Anniversary. That means that in 60 years we have had to find out a whole lot about water and its characteristics . . . for the very plain reason that our own manufacturing processes require the use of millions of gallons yearly.

Our business also takes us into many manufacturing fields where the relation between water and alkalies is extremely important to manufacturers' processes. We make, for instance, cleansers of various types for a variety of industries, which, in itself, requires a broad knowledge and experience of water conditions in every section of the country.

As manufacturers of Liquid Chlorine and Alkalies, used in both municipal and industrial water treatment, we have for years been in direct contact with water treating problems.

Much of this accumulated experience in the field of water treating can be yours merely for the asking. And with such a background, we do not feel it too much to say that water treating problems, whatever their nature, are "right down the alley" of Solvay Technical Service. Your inquiries are cordially solicited.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 RECTOR STREET NEW YORK, N. Y.

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TECHNICAL SERVICE

WATER and OIL DO MIX..

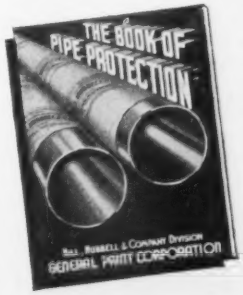
SHATTER-PROOF STEEL PIPE COATED-WRAPPED- *and* LINED *at the mill*

by the* HILL-HUBBELL *PROCESS

Was used to construct the above illustrated water supply line, to a Pennsylvania refinery's cooling equipment.

The long and successful use of STEEL PIPE for the transportation of oil is logically followed for the transportation of water.

Water works engineers increasingly appreciate the sound principles of "SHATTER-PROOF" steel design.



Write today for your copy of "THE BOOK OF PIPE PROTECTION" which describes our process in detail.

GENERAL PAINT CORPORATION

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(*Continued from page 34*)

tainment and arrangements made by Ernest L. H. Meyer, Executive Chairman of the Local Committee.

The usual Christmas meeting will be held on Tuesday, December 30, at the Hotel Commodore, New York, N. Y.

R. K. BLANCHARD
Secretary-Treasurer

"An Important Lesson in Law" is here reprinted from the September issue of *The Driller:* "No one should get messed up in a lawsuit without understanding that cases are decided by judges and juries on the basis of facts as they appear to the judge or jury. Actual facts not brought to the attention of the court cut no figure.

"The well driller, of course, must trust his lawyer to see that all facts favorable to him are proved. But the driller has a legitimate interest in what the Law calls "burden of proof," as illustrated by a decision rendered by the St. Louis Court of Appeals, in the case of Montague Compressed Air Co. v. City of Fulton, 166 Missouri Appeal Reports, 11.

"The Missouri case involved a question as to whether or not well pumping apparatus came up to the seller's guaranty that the pumps would

(*Continued on page 38*)

HANDY REPRINTS
of
Steel Pipe and Coating Specifications

Standard Specifications for Riveted Steel Pipe-7A.1—$.15

Tentative Standard Specifications for Lock-Bar Pipe-7A.2—$.15

Standard Specifications for Electric Fusion Welded Steel Water Pipe for Sizes 30 Inches and Over-7A.3—*and*

Standard Specifications for Steel Water Pipe of Sizes of 4 Inches up to but Not Including 30 Inches-7A.4—

Under one cover—$.25

Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes 30 Inches and Over-7A.5—*and*

Standard Specifications for Coal-Tar Enamel Protective Coatings for Steel Water Pipe of Sizes of 4½ Inches Outside Diameter up to but Not Including 30 Inches-7A.6—

Under one cover—$.30

Standard Specifications for Cement-Mortar Protective Coating for Steel Water Pipe of Sizes 30 Inches and Over-7A.7—$.20

American Water Works Association
22 East 40th Street, New York, N. Y.

Soundest STARTING POINT for Public Works Layouts...

Instrumentation by the Originators of Modern Process Control!

Sewage plant and water works layouts no longer can be based on cut-and-dried standards of a few years ago. Today, the operation of such plants is an exact process, requiring the same advanced instrumentation as an industrial process.

That's why more and more engineers now consult Foxboro for assistance in developing more efficient plant layouts. Foxboro engineers were earliest pioneers of modern process control instruments, and the originators of many important types, such as flow controllers, recording control instruments and throttling controllers with automatic reset. Through long experience in instrumenting processes in industry as well as public works, they are uniquely equipped to help you.

Discuss your problems with a Foxboro engineer. Also write for Bulletin 232 on sewage plants and Bulletin 233 on water works. The **Foxboro Company, 150 Neponset Avenue, Foxboro, Mass., U. S. A.** Branches in principal cities of U. S. and Canada.

FOXBORO
REG. U. S. PAT. OFF.
Instrumentation
FOR WATER WORKS AND SEWERAGE SYSTEMS

(Continued from page 36)

furnish 300 gallons of water per minute, conditioned that the wells will furnish 300 gallons per minute. After the apparatus was installed, the seller sued the buyer for the contract price. The buyer set up a counter-claim for damages, insisting that the pumps did not have the 300-gallon per minute capacity that the seller warranted they would have. It does not appear that there was any dispute over the fact that the pumps did not furnish that quantity of water. The vital point of dispute was whether the deficiency in water pumped was due to the pumps, or was due to the fact that there was not enough water in the wells to furnish 300 g.p.m.

"So this legal question came up: was it up to the seller to prove that there was not enough water in the wells to furnish the desired supply, or was it up to the buyer to prove that there was enough water in the wells. It was an important question because if it was up to the seller to prove insufficiency of water in the wells he could not win his case unless there was proof of that fact. On the other hand, if it was up to the buyer to prove that there was sufficient water in the wells the seller was entitled to collect the price in full, unless the buyer proved that there was enough water in the well and that therefore the deficiency of water at the top of

(Continued on page 40)

STOP RUST
with
RUSTOP

Cathodic Protection ends rust
•
Cleans old tanks
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Keeps new tanks clean
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No paint—No taste
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Write for estimate

ELECTRO RUST-PROOFING Company
29 W. Apple Street
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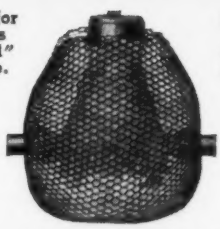
THE FORD METER MITTEN
WILL SAVE FROZEN METERS

Made for meters up to 1" in size.

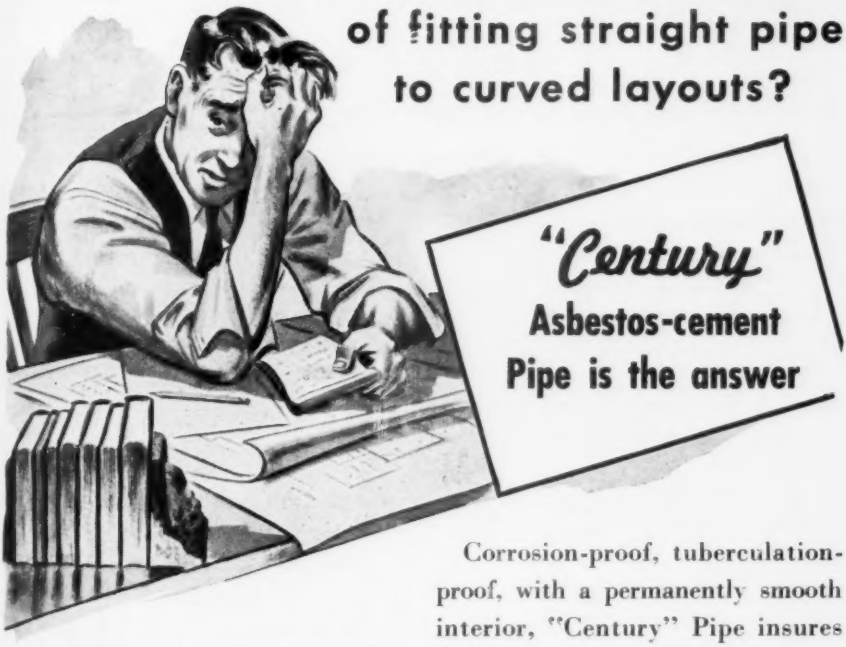


Simple and easy to install.

The Meter Mitten is a convenient and effective insulation jacket for basement meters. Conserves warmth in meter and water and prevents many meters from freezing. Costs but a fraction of the expense of a frozen meter. Write for further information.

The Ford Meter Box Co.
WABASH, INDIANA

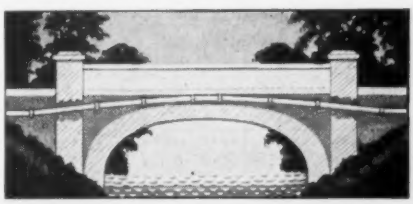
Why make a problem of fitting straight pipe to curved layouts?



WHEN installing an entirely new distribution system of "Century" Asbestos-cement Pipe in West Deptford, N. J., township officials learned from actual experience how easy it is to curve a "Century" Pipe line without using elbows or bends.

Where the line crossed a concrete bridge, the sections of pipe were cut into short lengths and joined with "Century" Flexible Couplings. This permitted curving the line upward to the crest of the bridge, running it straight across, then curving it down on the other side. Even vertical curves, such as this one, are easy with "Century" Pipe and Couplings.

Corrosion-proof, tuberculation-proof, with a permanently smooth interior, "Century" Pipe insures lasting, low-cost service without maintenance. Its light weight and handling ease cut installation cost. And its "Century" Flexible Couplings cannot leak. Write Dept. 1017 for free catalog, "Mains without Maintenance."



Diagrammatic view of the installation at the bridge, showing how short lengths of pipe joined with "Century" Flexible Couplings form a vertical curve in the line over the bridge.

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

COOK Well Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

A. D. COOK, INC.
Lawrenceburg - Indiana

COOK Deep-Well Turbine Pumps

(*Continued from page 38*)

the well was due to the pumps not being of warranted capacity. The lawyers kept shoving this "buck," the burden of proof, back and forth between them, and the Court of Appeals had to settle the question.

"The Court of Appeals decided that since the pumps were sold under a warranty of the stated capacity, and since they failed to deliver the required quantity of water it was up to the seller to show that the fault lay, not in the pumps, but in the fact that there was not enough water in the wells to furnish a supply of 300 gallons per minute."

A Public Work Reserve Organization has been established by John M. Carmody, Federal Works Administrator. The plan is to map out the needs and establish data on capital improvements and on various types of public services so that in a post-war transition period there would be already available groundwork for projects totaling up to 30 millions for a six-year program. The inventory is being made up without regard to type or possibilities of financing. The public work programs of all governmental units down to towns are being included. Administrator Carmody has appointed 35 state directors as listed below. Where no city is given, a headquarters is not yet definitely established.

State Directors Appointed by Public Work Reserve

Arkansas (Little Rock)	Edward S. Dudley, W.P.A. Office Engineer on road construction
Colorado and Wyoming	Douglas H. Platt, W.P.A. State Field Engineer at Denver
Florida (Jacksonville)	A. J. Little, W.P.A. State Administrator for Florida
Georgia (Atlanta)	John L. Peters, W.P.A. Field Representative at Atlanta

(*Continued on page 42*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

ZEOLITE CHEMICAL CO.
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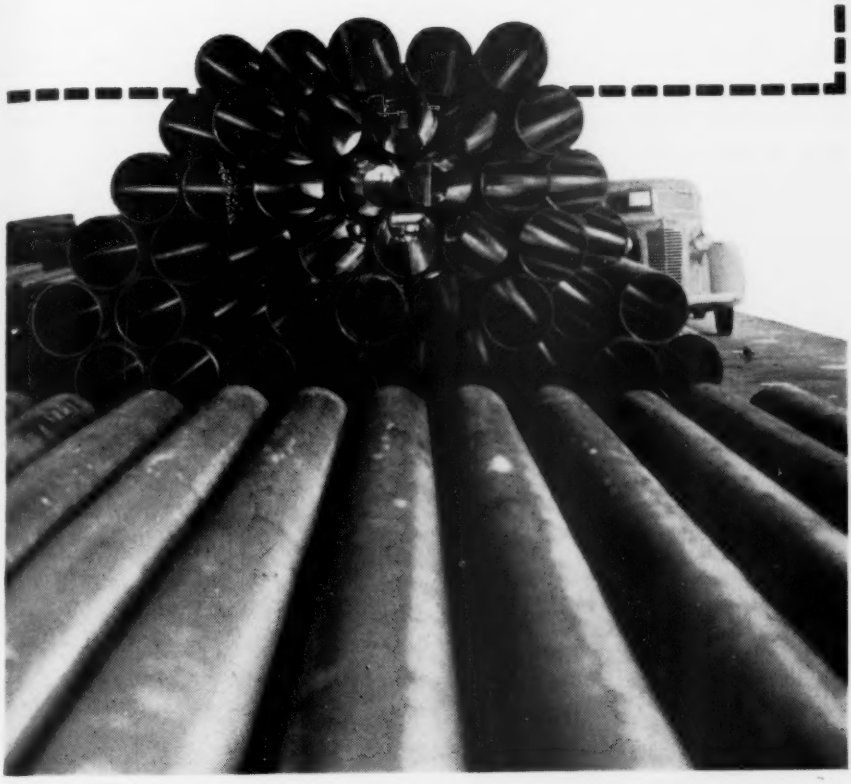
SUPERIOR PROTECTION AT LOWER COST ... BARRETT ENAMELS



U. S. ARMY CAMP, CALIF. BARRETT WATERWORKS ENAMELS

Barrett WATERWORKS ENAMEL

FIELD SERVICE—The Barrett Waterworks Service Department and staff of Field Service men stand ready to provide a broad measure of cooperation. These services include consultation on technical details, training of crews, and job inspections.

EXPERIENCE has demonstrated that pipelines protected with Barrett Waterworks Enamel retain their original efficiency . . . for Barrett Enamel produces a glass-smooth interior lining that keeps the coefficient of flow high throughout the pipeline life.

Barrett Enamels are made from the most stable and durable bituminous material known for underground pipeline protection. Highly dielectric, water tight, resistant to mechanical distortion, these superior coatings meet the American Water Works Association's standard specifications 7A.5 and 7A.6 (1940).

The original cost of Barrett Enamel is low. So, too, is cost per year of service. The assistance of Barrett-trained field men is available on all jobs for which Barrett Enamel is specified.

THE BARRETT COMPANY 40 RECTOR STREET NEW YORK, N. Y.

(*Continued from page 40*)

Idaho	Edward P. Horsfall, W.P.A. State Field Engineer at Boise
Illinois	Ross Caldwell, Illinois Dept. of Public Works and Buildings
Indiana (Indianapolis)	Virgil M. Simmons, Special Consultant, Federal Security Agency
Iowa (Des Moines)	Donald Tormey, W.P.A. Safety Consultant for Iowa
Kansas (Topeka)	Lawrence F. Whearty, W.P.A. Manager for District 1
Louisiana (New Orleans)	A. J. Negrotto, General Supt., state-wide highway project in Louisiana
Massachusetts	Howard C. Williams, private practicing architect and engineer at Boston
Michigan (Lansing)	Floyd S. Benjamin, Manager, W.P.A. District 1
Minnesota (St. Paul)	A. H. Douglass, Assistant W.P.A. District Operations Supervisor in Minnesota
Missouri (Jefferson City)	Howard C. Williams, Manager for W.P.A. District 2
Mississippi (Jackson)	Isaac S. Reed, W.P.A. State Planning Engineer for Mississippi
Montana	Martin Kelly, former Traveling Engineer for P.W.A.
Nebraska (Lincoln)	Lloyd A. Woodward, Engineer of Gage County, Neb.
New Jersey (Newark)	Joseph J. O'Loughlin, W.P.A. Assistant State Director of Operations Division

(*Continued from page 44*)

Every part of a Layne Well Water System will stand the heaviest duty; the hardest grind and longest non-stop runs. They are built to stand up—and give you far more than might be expected. Dollar for dollar they will pay greater dividends. Write for Catalogs, Folders and Bulletins. No obligation. LAYNE & BOWLER, INC., Memphis, Tenn.

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The WATER DEPARTMENT SUPT. likes Safetop *Economy* - -

Negligible maintenance expense, ample strength to resist breakage from ordinary impacts, and repair costs that are less than 1/5 those of other hydrant designs in case of breakage due to smashing collisions.

The FIRE CHIEF likes Safetop *Convenience* - -

Convenient nozzle height, nozzle caps that unscrew quickly and drop out of the way, simple straightline operating mechanism, and full main pressure at the nozzles.

The HYDRANT MAINTENANCE MAN likes Safetop *Reliability* - -

Freedom from trouble calls, because Safetops are flood-proof, frost-proof, corrosion-proof and tamper-proof. In addition, they are readily lubricated, and their tough, grit-resisting valve facings last indefinitely.

The NEIGHBORHOOD HOUSEHOLDER likes Safetop *Protection* - -

No danger of flooding if accidentally broken, no interruption of water service or street excavation, and speedy return to service if breakage repairs or extension for change of street grade are necessary.

The TRUCK CHAUFFEUR likes Safetop *Safety* - -

No likelihood of serious personal injuries in case of unavoidable collision against the hydrant due to slippery streets or traffic accidents. No fire hydrant is worth a human life.

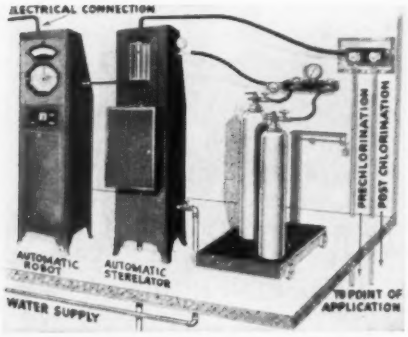
The Kennedy Valve Mfg. Co., Elmira, N. Y.

KENNEDY
SAFETOP
REG. U.S. PAT. OFF.
FIRE HYDRANT

(*Continued from page 42*)

New Mexico	Richard Gardner, W.P.A. State Field Engineer at Santa Fe
North Carolina (Raleigh)	James L. Hales, W.P.A. Field Engineer
North Dakota (Bismarck)	Lee O. Hughes, W.P.A. Safety Consultant in North Dakota
Ohio (Columbus)	Frank L. Ritter, former engineer with Ohio Highway Dept.
Oregon	Wallis W. Bartlett, W.P.A. Assistant Civil Engineer at Portland
Pennsylvania (Phila.)	E. K. Hunter, former partner in Michigan architectural firm of W. P. N. Hunter Co.
South Carolina (Columbia)	Torrence G. Hanner, former W.P.A. State Supply Manager for South Carolina
South Dakota (Mitchell)	John G. Dorsey, Manager, Dakota Brewing Co., Huron
Tennessee (Nashville)	M. W. Snoderly, City Manager of Johnson City, Tenn.
Texas (Dallas)	John C. Douglass, Chief Engineer and Business Mgr., Southern Division, National Gunite Contracting Co.
Utah	T. H. Humphreys, former State Engineer for Utah
Virginia (Richmond)	Thomas H. Greene, W.P.A. Safety Representative at Richmond

(*Continued on page 46*)



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The new EVERSON Electric Robot Controlled Automatic Proportioning SterElator is the last word in waterworks and sewage plant chlorinating equipment.

1. Automatically proportions gas flow to water flow, mixes and feeds chlorine in solution and indicates gas flow.
2. Robot indicates and records the water flow and totalizes gas flow.
3. Operates under *substantial* vacuum (2 inches of mercury).
4. Completely protected automatic safety devices . . . automatic shut-off, automatic siphon breaks, etc.

Write for Bulletin describing the complete line of manually controlled, semi-automatic and Robot controlled EVERSON SterElatorS.

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UNIVERSAL CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.

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●

WATER PURIFICATION EQUIPMENT
Water Softeners Pressure Filters

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HELP PROMOTE YOUR ASSOCIATION BY INTERESTING YOUR FRIENDS AND CO-WORKERS IN IT.

Send for application blank

American Water Works Assn.
22 East 40th Street, New York

(*Continued from page 44*)

Washington	John T. Burdett, W.P.A. Senior Engineer at Seattle
West Virginia (Charleston)	S. Grover Smith, former Director of W.P.A. in District 6 in West Virginia
Wisconsin (Milwaukee)	Leo J. Voell, former state W.P.A. Director for Wisconsin
Southern California and Arizona	Albert J. Bateman, City Engineer of Lynwood, Calif.
New Hampshire, Maine and Vermont	James D. Cash, W.P.A. Constr. Supt.

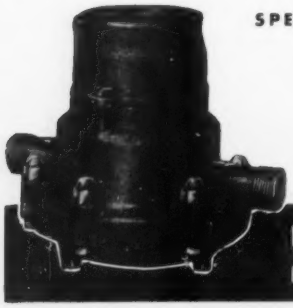
Submersible pump hydropneumatic pressure system installations are described in a recent news letter issued by the Pump Division of Byron Jackson Co., Los Angeles, Calif. An installation made in a drilled well, 16 in. in diameter and 260 ft. deep, at Tuscon, Ariz., is detailed.

Porous plate underdrains for filters are completely described and illustrated in the recent Engineering Bulletin No. 2 issued by the Carborundum Company, Niagara Falls, N. Y. A list of more than 70 plants now employing Aloxite Porous Undergrain Systems is put forth by the company.

Two sewer joint compounds, hot pouring and cold troweling types, have been announced by Keystone Asphalt Products Company, 43 East

(*Continued on page 48*)

FIRST QUALITY METERS EXCLUSIVELY



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Water Meters
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PHILLIPSBURG, N. J.
EVERETT, MASS.

(Continued from page 46)

Ohio St., Chicago. A variation in packing is substitution of a heavy cardboard container for the usual steel drum.

Hays Mfg. Co., Erie, Pa., has just issued a 32-page catalog describing and illustrating its many products for the water works field: ground key curb stops for iron pipe; lead pipe, flanges and tools; compression stops; corporation stops for all tapping machines; and the Hays copper service method.

Citizen's Business, the bulletin of the Bureau of Municipal Research, Philadelphia, reports that:

"A survey, now under way, to detect and stop leakage in the city's water-distribution system, and to test the accuracy of large water meters, is the first comprehensive survey of this kind in Philadelphia since 1931. Like previous surveys, it is revealing numerous conditions requiring correction.

"The present survey was begun last year, when the city sponsored a WPA project and let a contract for a water-waste study in West Philadelphia. The contracting company, a specialist in this work, was required to locate underground leaks, measure the discharge of pumps, measure the total water consumption, test the accuracy of meters over 3 inches in size, and detect unauthorized use of city water. Work in West Philadelphia has been completed and a report giving the results was submitted to the city in January 1941. An extension of this survey, similarly financed, is now under way in South Philadelphia. Distribution surveys of this kind have been made from time to time in the past, but between surveys little comprehensive work has been done. Ten years ago, in 1931, a survey of the entire city, begun in 1925, was completed; other surveys were made in 1905–1907 and 1912–1915.

"In West Philadelphia, 202 underground leaks wasting an estimated total of 2,908,000 gallons of water a day were found by the present survey. Of these leaks, 154 were in service pipes which wasted 1,418,000 gallons a day. In addition, 25 abandoned services wasted 503,000 gallons, 11 broken mains wasted 781,000 gallons, and 6 leaking joints wasted 60,000 gallons a day. Six miscellaneous leaks wasted 146,000 gallons a day. Defective valves and hydrants were specifically reported. The tests of meters revealed that many were underregistering—from very little to almost 100%. Some meters were not registering at all; one registered more water than passed through it. Because of meter inaccuracy, the city was failing to charge for 2,502,000 gallons of water taken daily.

"Less underground leakage, but greater underregistration of meters, was found in the present survey of West Philadelphia than in a survey of the same area reported upon in October 1927. The earlier survey dis-

(Continued on page 50)

FOR EFFECTIVE CONTROL OF ALGAE

and Removal of Tastes and Odors in Water Supplies

Use NICHOLS TRIANGLE BRAND COPPER SULPHATE

99% + PURE

Many of the country's most important water supply systems today depend on Nichols Triangle Brand Copper Sulphate for preventing the growth of micro-organisms. Frequent applications of small quantities of Nichols Copper Sulphate reduce such growths to a minimum, thereby eliminating an important source of taste and odor trouble.

SIMPLE, EASY TO USE. For treatment of reservoirs, lakes and swimming pools (by any one of the conventional simplified dry or solution feed methods at hand) Nichols Triangle Brand Copper Sulphate is supplied in several convenient forms for water treatment —LARGE CRYSTALS, SMALL CRYSTALS, GRANULATED, "SNOW" AND "INSTANT" form. These products are packed in high-grade barrels of 450 lbs. net, and in the newest type waterproof bags of 100 lbs. net as an additional safety factor during transit and storage. *Fast deliveries from three large plants!*

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More practical, more economical

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PERMUTIT

WATER CONDITIONING HEADQUARTERS

(*Continued from page 48*)

covered 253 leaks wasting an estimated total of 5,148,000 gallons a day, or 2,240,000 gallons more than the losses recently uncovered. Although tests were made of the same sizes of meters, a total underregistration of only 477,000 gallons a day was reported in 1927, or 2,025,000 gallons less than the present findings. During the previous survey, house inspections were made to detect waste through leaking plumbing fixtures, and 2,932 leaking fixtures wasting 4,306,000 gallons a day were found. The current survey does not include house inspections, but it reveals areas where house waste is probably occurring."

The State of Connecticut has formally become a member of the Interstate Sanitation Commission, making a third signature to the compact signed five years ago by New Jersey and New York. The Commission's work is to control pollution of waterways, chiefly in the New York Metropolitan area. Waters are classified according to their chief use and treatment standards established for discharges to these waterways. Under the Commission 27 municipal sewage disposal plants have been built or started.

STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere

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A DEPENDABLE SELF - CAULKING JOINT COMPOUND

News of the Field

Critical Materials Prohibited for Non-Defense Construction

The most far reaching and sweeping step yet taken in supply priorities and allocations to enhance national defense efforts is the curtailment of non-defense construction as set forth in the Supply Priorities and Allocation Board's release of October 9, given in full below. The report emphasizes the importance of health defense as well as direct defense efforts, so water works men are again assured of assistance in construction immediately necessary.

"The Supply Priorities and Allocations Board today announced a new policy under which *no* public or private *construction* projects *which use critical materials* such as steel, copper, brass, bronze, aluminum, etc., *may be started* during the emergency *unless* these projects are either necessary for *direct* national *defense or* are essential to the *health* and *safety* of the people. [Editor's italics.]

"This applies to public projects—federal, state and local—such as the building of postoffices, courthouses and similar structures; to the construction of roads and highways; to river and harbor improvements; and to flood control and power projects. It applies to the construction of factories, lofts, warehouses, office buildings and all other commercial construction. It applies to residential construction and to construction for public utilities.

"SPAB pointed out that because of the defense program's heavy demand for metals it will not be possible for the United States to build all of the warships, planes, tanks, and other things essential to its national security if the scarce metals are unnecessarily used in building projects which are not vital to defense.

"In effect, the new policy means that on all building projects hereafter two tests will be applied:

"1—Does this construction involve the use of appreciable quantities of critical materials?

"2—Is the construction directly necessary for national defense, or clearly essential for the health and safety of the civilian population?

"If the answer to the first question is 'yes' and the answer to the second question is 'no,' priorities for the critical materials involved will not be issued.

"Where construction actually has started and a substantial portion has been completed, SPAB said, efforts will be made to get the critical materials needed to finish the job.

"The entire policy, SPAB held, is based on the fact that no construction job which is not absolutely necessary is entitled to a share of the

(*Continued on page 2*)

(*Continued from page 1*)

materials urgently needed for defense. If factories are obliged to close because they cannot get these materials, SPAB said, there would be neither rhyme nor reason in permitting the use of those same materials to erect public works, new factories, office buildings or other structures unless it could be shown plainly that such construction is vital to the nation.

"SPAB urged all federal, state and local government agencies to refrain from issuing permits or other authorizations for construction work on which priorities assistance would have to be denied.

"It also suggested that building codes in many cities require the use of excessive amounts of critical materials, and urged that such codes be suspended during the emergency.

"In arriving at this policy, SPAB surveyed the entire field of construction to see what quantities of critical materials are used, how much money is involved, how much labor is employed and what defense and civilian needs are being met.

"Total construction during 1941, SPAB found, will probably reach $11,000,000,000—about equal to the highest levels previously reached in 1926 and 1927. This figure does not include approximately $3,000,000,000 which is being spent during the year on maintenance, repair and remodeling.

"Of the $11,000,000,000, about $4,900,000,000 is being spent on defense construction, as follows:

Military Construction	$1,800,000,000
Industrial Facilities	1,700,000,000
Defense Housing	1,200,000,000
Defense Highways	200,000,000

"Non-defense construction for the year totals $6,300,000,000. The breakdown here is as follows:

Residential Construction	$1,800,000,000
Industrial Construction	500,000,000
Public Works	1,500,000,000
Commercial Building	900,000,000
Public Buildings	400,000,000
Privately Financed Utilities	700,000,000
Farm Construction	500,000,000

"The critical material chiefly used in construction work, is, of course, steel. The 1941 construction program is using about 13,800,000 tons of steel ingots—roughly $\frac{1}{6}$ of the year's total consumption—of which approximately 6,300,000 tons are being used for non-defense construction. Industrial and public buildings are the chief sources of demand for steel in the non-defense construction area.

(*Continued on page 4*)

WHERE TUBERCULATING WATERS MUST BE TRANSPORTED

(LESS THAN 25% OF THE U. S. A.)

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THE areas of the United States where tuberculating waters materially affect the carrying capacity of pipe represent *less than one-quarter of the total area of the country.* If you are located within one of these areas, use *lined* cast iron pipe. You do *not* have to sacrifice the long life, low maintenance cost and salvage value of cast iron pipe in order to be assured of high carrying capacity throughout the life of the pipe you buy. The Cast Iron Pipe Research Association recommends *lined* cast iron pipe where tuberculating waters must be transported. Lined cast iron pipe is the only pipe that will have 100 years of useful life plus 100 years of high carrying capacity. Send for map which shows approximately 76% of the country where little or no tuberculation is to be expected. Lined cast iron pipe is made in sizes from 1¼ to 84 inches.

**Various types of linings are available to meet various conditions and preferences of users.*

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CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(Continued from page 2)

"SPAB estimated that under the restricted program, steel used in non-defense construction could be held to less than 3,000,000 tons. These savings would be partially offset by the fact that defense construction in 1942 would require about 1,200,000 more tons of steel than were used in defense construction during the current year.

"In addition, SPAB suggested that extensive additional savings might be made through substitution and conservation. In many types of public works and buildings the use of steel can be almost entirely eliminated. Reinforced concrete pipes can be used in place of steel for water mains. Buildings erected for emergency use can be built to less stringent specifications than those designed for permanent use, and hence can be built with less steel.

"Employment in all types of construction in 1941 has averaged about 2,400,000 men, with a peak of 3,100,000 men reached in the present month. Defense construction is employing 1,200,000 workers. Non-defense construction employs 1,500,000 and 400,000 men are at work on maintenance, repairs and remodeling.

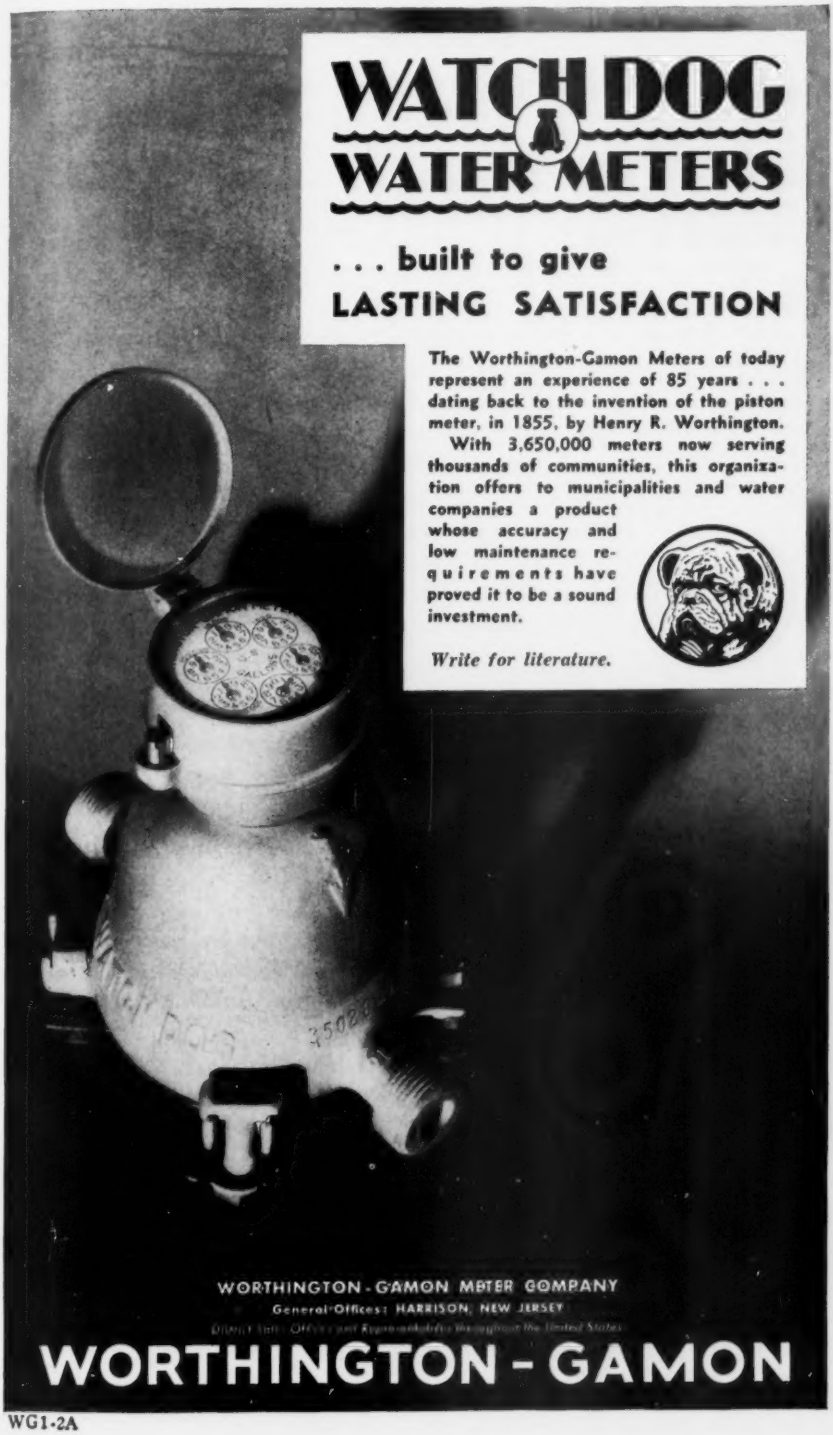
"SPAB's studies indicate that defense construction next year will require about the same number of workers that it now uses. The amount of maintenance, remodeling and repair work during the year is expected to be roughly equal to the volume in 1941. Principal reductions in employment, therefore, will occur in the field of non-defense construction.

"In that field, SPAB pointed out, growing shortages of critical materials would cause a considerable displacement of workers even if a policy of restricting non-defense construction were not adopted. In areas where defense work is being done, it is believed that other types of employment will rapidly absorb construction workers displaced through cessation of non-defense building; and, in any case, it was pointed out that the drop in construction employment will be a drop from a peak and not from normal levels, employment at present being higher than at any time since 1930."

Cities are exempt from most new federal taxes under Sec. 2406—Tax-Free Sales of the Federal Revenue Act of 1941: "Under regulations prescribed by the Commissioner with the approval of the Secretary, no tax under this chapter shall be imposed with respect to the sale of any article—(a) for the exclusive use of the United States, any State, Territory of the United States, or any political subdivision of the foregoing, or the District of Columbia. . . ."

Under the Act of 1941, some new excise taxes are imposed, higher rates are effective for other taxes, and some taxes previously temporary are made permanent. Municipalities in general should not pay the taxes but

(Continued on page 6)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WATER METERS
. . . built to give
LASTING SATISFACTION
The Worthington-Gamon Meters of today represent an experience of 85 years . . . dating back to the invention of the piston meter, in 1855, by Henry R. Worthington.
With 3,650,000 meters now serving thousands of communities, this organization offers to municipalities and water companies a product whose accuracy and low maintenance requirements have proved it to be a sound investment.
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WORTHINGTON - GAMON

WG1-2A

(*Continued from page 4*)

should file a properly executed certificate of exemption with merchants or dealers. At time of writing, these forms are not available, but municipalities are advised to be guided by the example of an exemption form given in Regulations 46 (1940 Edition, p. 17). Invoices should show the gross price, the amount of tax, and the net price to the municipality. The sales taxes based upon the manufacturer's sales prices, and from which cities may claim exemption, are: the 10 per cent tax on business and store machines; electric, gas, and oil appliances; electric signs; luggage; mechanical refrigerators and air conditioners; musical instruments; optical equipment; phonographs and phonograph records; photographic apparatus; radio receiving sets, tubes, and parts; rubber articles except footwear and articles for surgical or hospital use; sporting goods; and washing machines.

There is a 5 per cent tax on electric light bulbs and tubes, $1\frac{1}{2}$ cents a gallon on gasoline, 11 per cent on firearms, shells, cartridges, $4\frac{1}{2}$ cents a gallon on lubricating oil, 9 cents a pound on inner tubes, and 5 cents a pound on tires, 7 per cent on passenger automobiles, 5 per cent on buses, trucks, and semitrailers, and automobile parts and accessories, as well as tractors, and 7 per cent on motorcycles. There is also a 10 per cent retailers' excise tax on furs, jewelry, and toilet preparations, and an excise tax of 1 cent a ton on bituminous coal.

Municipalities are exempt from the new taxes on telephone, telegraph, and burglar alarm service, and also from the new 5 per cent tax on payments for transportation of persons by rail, bus, boat, and airplane. There is no specific provision in the law granting public bodies exemption from the tax on rental of safe deposit boxes, which has been increased from 11 to 20 per cent, but in the past exemption has been secured by some cities. The 3 per cent tax on electrical energy does not apply to publicly owned utilities nor to electricity purchased for use by public agencies. Municipalities also are exempt from the annual tax on the use of motor vehicles ($5.00) and boats ($5.00 to $200), effective next February 1.

F. G. Doggett, Superintendent of the Mount Airy, N. C., Water Dept., has accepted a position with the North Carolina State Board of Health. Wade R. McKinney is the new Superintendent at Mount Airy.

W. W. Towne, Director, Div. San. Eng., South Dakota State Board of Health, is now on leave of absence serving as Visiting Assistant Professor, Dept. of Civ. Eng., University of Missouri. E. R. Mathews is serving as Acting Director of the South Dakota Div. San. Eng.

(*Continued on page 8*)

"That's 13 orders in 12 months from Newcastle!"

K&M "Century" PIPE

The City of Newcastle, Indiana, placed a small initial order for "Century" Pipe with the idea of checking its installed cost and performance. But after that first lot of K&M "Century" asbestos-cement Pipe had been laid, repeat orders came in regularly—12 more, in fact, in 12 months.

"Century" Pipe's light weight makes for quick installation. The flexible joints can be set up easily by unskilled men with simple wrenches. The lastingly smooth bore keeps pumping costs low, for this pipe is free from corrosion, electrolysis and tuberculation.

You, too, can save money with "Century" Pipe, especially with sizes 6 in. and 8 in., class 150, which are now available in new 18 ft. lengths for even faster installation. Let us send you full information on this economical asbestos-cement pipe that gives such long trouble-free service. Write Dept. 1017 for free booklet, "Mains without Maintenance."

Nature made asbestos; Keasbey & Mattison has made it serve mankind—since 1873.

"Century" Pipe is still available without delay. Since we are cooperating fully with the National Defense Program, we cannot tell how much longer this favorable situation will continue.

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

(*Continued from page 6*)

The current law on sabotage of water works: An Act of the Congress of the United States (Chapter 926-3D Session—76th Congress) to amend an Act entitled "An Act to punish the willful injury or destruction of war material, or of war premises or utilities used in connection with war material, and for other purposes," approved April 20, 1918.

"SECTION 4. That the words national-defense material, as used herein, shall include arms, armament, ammunition, livestock, stores of clothing, food, foodstuffs, fuel, supplies, munitions, and all other articles of whatever description and any part or ingredient thereof, intended for the use of the United States in connection with the national defense.

"The words national-defense premises, as used herein, shall include all buildings, grounds, mines, or other places wherein such national-defense material is being produced, manufactured, repaired, stored, mined, extracted, distributed, loaded, unloaded, or transported, together with all machinery and appliances therein contained; and all forts, arsenals, navy yards, camps, prisons, or other military or naval stations of the United States.

"The words national-defense utilities, as used herein, shall include all

(*Continued on page 10*)

STRONG - TIGHT AND FLEXIBLE!

Regardless of where you lay cast iron water mains —under paved streets, railroads or over bridges— you can depend on HYDRO-TITE to make joints that are not only strong, tight and flexible but "lasting". HYDRO-TITE is easy to prepare and use. It has a record of over 25 years without a single failure anywhere.

HYDRAULIC DEVELOPMENT CORPORATION

Main Sales Office: 40 Church Street, New York, N. Y.
General Offices and Works: West Medford Station, Boston, Mass.

A Symbol of Quality

HYDRO-TITE
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A DEPENDABLE SELF - CAULKING JOINT COMPOUND

Another Reason for Rensselaer Quality

A transverse and deflection test of a Cast Iron Bar on a Riehle Testing Machine.

Tests are made daily of all Iron and Bronze used in Rensselaer Valves, Hydrants and other Products, to maintain QUALITY of the highest standards.

Buy RENSSELAER for QUALITY

Iron used is made by the "Sorbo-Mat" Process

RENSSELAER VALVE CO.

TROY, N. Y.

(*Continued from page 8*)

railroads, railways, electric lines, roads of whatever description, railroad or railway fixture, canal, lock, dam, wharf, pier, dock, bridge, building, structure, engine, machine, mechanical contrivance, car, vehicle, boat, or aircraft, or any other means of transportation whatsoever, whereon or whereby such national-defense material, or any troops of the United States, are being or may be transported either within the limits of the United States, or upon the high seas; and all dams, reservoirs, aqueducts, water and gas mains and pipes, structures, and buildings, whereby or in connection with which water or gas may be furnished to any national-defense premises or to the military or naval forces of the United States, and all electric light and power, steam or pneumatic power, telephone and telegraph plants, poles, wires, and fixtures and wireless stations, and the buildings connected with the maintenance and operation thereof used to supply water, light, heat, power, or facilities of communication to any national-defense premises or to the military or naval forces of the United States.

"SECTION 5. That whoever, with intent to injure, interfere with, or obstruct the national defense of the United States, shall willfully injure or destroy, or shall attempt to so injure or destroy any national-defense material, national-defense premises, or national-defense utilities, as herein

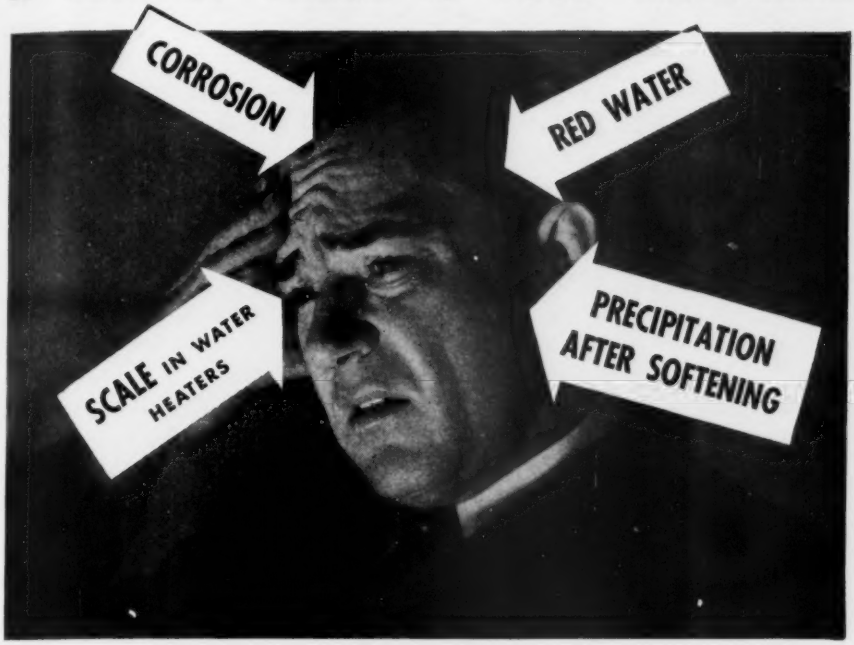
(*Continued on page 12*)

William Flannery, Chief Engineer of the New York Department of Water Supply, Gas and Electricity, died on October 18 of a heart attack at his apartment in Brooklyn. He was 62.

In 1908 Mr. Flannery joined the Department as a draftsman and later served as Chief of the Material Inspection Division and Mechanical Design Division. He became Deputy Chief Engineer in May, 1940, and Chief Engineer in May, 1941. Mayor F. H. LaGuardia said, when notified of the death of Mr. Flannery: "In losing Mr. Flannery, the people of New York City have lost an exceptional public servant. Mr. Flannery . . . rose through almost every grade in the Department to be the Chief Engineer. . . .His outstanding ability got him his final promotion, and he will be mourned by all who knew him and worked with him."

Mr. Flannery was a native of Brooklyn and attended St. Francis Xavier College, from which he received an A.B. degree in 1898. He was graduated as Mechanical Engineer from Stevens Institute of Technology, Hoboken, N. J., in 1902. Before joining the New York City Dept., he had served for six years in the mechanical departments of the New York Central Railroad, and with the Stehlin-Miller Construction Co. He had been an Active Member of the A. W. W. A. since 1921.

IF ANY OF THESE IS YOUR HEADACHE



—you need Calgon Treatment!

CALGON solves four major water troubles. It controls corrosion, prevents precipitation of dissolved iron, stabilizes water after lime or lime-soda softening and prevents scale formation from hard, high-bicarbonate waters.

At first glance, it might seem impossible for one product to be effective in such widely varying applications but here's how it works:

CORROSION CONTROL. Calgon forms a thin protective film on metals and metal oxides at pH values of 5.0 and higher. This reduces the attack of oxygen to such an extent that corrosion ceases to be a problem.

PREVENTION OF RED WATER. Calgon has the property of preventing the precipitation of dissolved iron. Thus, red water from iron initially present in a well water can be eliminated as well as that derived from corrosion.

STABILIZATION OF WATER following lime or lime-softening. Calgon's ability to inhibit crystallization of many slightly soluble substances prevents precipitation of calcium carbonate in mains, meters and consumers' hot-water heaters. It stabilizes water to the ends of the system.

PREVENTION OF SCALE from hard, high-bicarbonate waters. Calgon, added at the plant, prevents scale formation in consumers' water-heater coils throughout the city system.

LOW COST OF CALGON. The small amount of Calgon needed—from 0.5 to 2 ppm.—keeps the cost low.

Your consumers will be highly pleased with the elimination of red water and scale troubles. Why delay starting Calgon* treatment? The sooner you begin, the sooner their troubles—and yours—will cease. Tell us your problem when you write for complete information.

**Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products.*

calgon, inc.
300 ROSS ST PITTSBURGH, PA

(*Continued from page 10*)

defined, shall, upon conviction thereof, be fined not more than $10,000 or imprisoned not more than ten years, or both.

"SECTION 6. That whoever, with intent to injure, interfere with, or obstruct the national defense of the United States, shall willfully make or cause to be made in a defective manner, or attempt to make or cause to be made in a defective manner, any national-defense material, as herein defined, or any tool, implement, machine, utensil, or receptacle used or employed in making, producing, manufacturing, or repairing any such national-defense materials, as herein defined, shall, upon conviction thereof, be fined not more than $10,000 or imprisoned not more than ten years, or both." [Approved November 30, 1940.]

Malcolm Pirnie, Jr., who joined the U. S. Public Health Service on June 1, is now located at Baltimore, assisting the Maryland State Dept. of Health in setting up mosquito control projects in defense areas. This is a nation-wide effort toward mosquito control, and the U. S. Public Health Service is employing many sanitary engineers to accomplish this in the various states.

(*Continued on page 14*)

MANUAL OF WATER QUALITY AND TREATMENT

ORDER NOW

The Manual of Water Quality and Treatment culminates many years of intensive investigation and is the absolute authority in its field. Price to members, $2.50; to members for cash with order, $2.25; and to non-members, $3.00. Write for your copy today.

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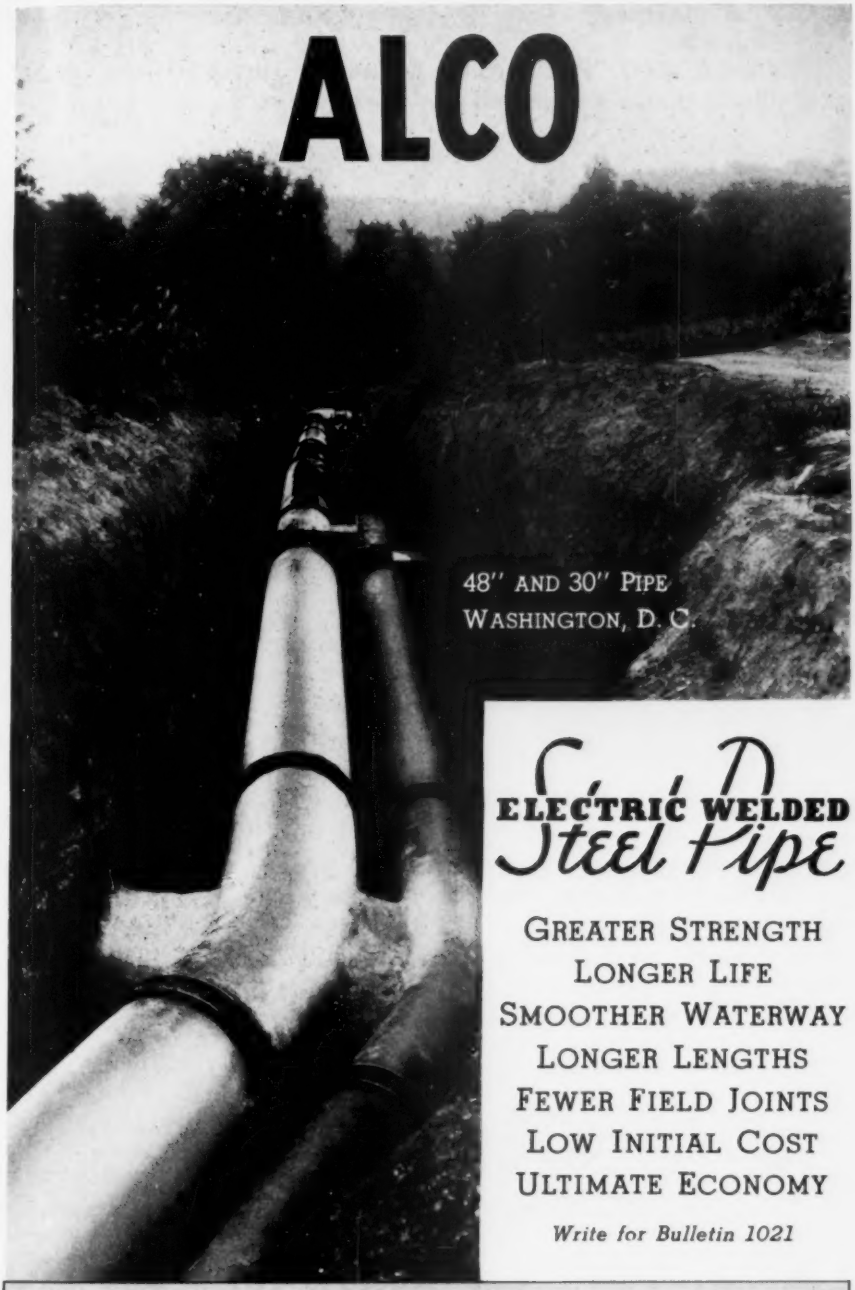
22 East 40th Street, New York



ELECTRIC WELDED
Steel Pipe

GREATER STRENGTH
LONGER LIFE
SMOOTHER WATERWAY
LONGER LENGTHS
FEWER FIELD JOINTS
LOW INITIAL COST
ULTIMATE ECONOMY

Write for Bulletin 1021

AMERICAN LOCOMOTIVE COMPANY
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. DUNKIRK, N. Y.

(*Continued from page 12*)

An epilogue for "Studies on the Accuracy of Threshold Odor Values" in the text portion of this JOURNAL:

Song of the Quoodle

They haven't got no noses
The fallen sons of Eve,
Even the smell of roses
Is not what they supposes,
But more than mind discloses
And more than men believe.

The brilliant smell of water,
The brave smell of a stone,
The smell of dew and thunder,
The old bones buried under,
Are things in which they blunder
And err, if left alone.

And Quoodle here discloses
All things that Quoodle can:
They haven't got no noses
They haven't got no noses,
And goodness only knowses
The noselessness of man.

—G. K. CHESTERTON

Archie Frew, for ten years employed as chemist by the Vincennes, Ind., Water Dept., has accepted the position of Water Engineer, with the E. I. du Pont de Nemours Co., operating the Kankakee, Ill., Ordinance Works near Wilmington, Ill. The Company is engaged in the manufacture of T.N.T.

(*Continued on page 16*)

ZECO GREENSAND ZEOLITE

Engineering service, designs, equipment, and construction for water supply and water purification works of all kinds.

ZECO and HI-ZECO Greensand Zeolite for water softening, filtration and iron removal. ZECO Manganese Zeolite for iron and manganese removal. Corexite mineral for corrosion and water stabilization.

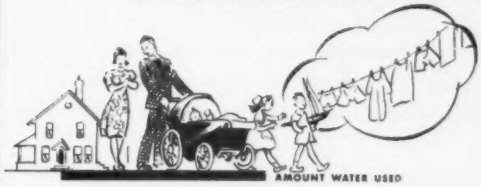
ZEOLITE CHEMICAL CO.
90 WEST STREET **NEW YORK, N. Y.**

Water Meters Distribute Water Costs FAIRLY

HERE are three families, two of them economical, one of them wasteful. They all live in houses which, under the flat rate system, would be rated equally. Let's see how they would fare on a metered rate if the city were to receive the same gross income from all three as it did on the flat rate.

AMOUNT WATER USED
AMOUNT PAID FOR—FLAT RATE
AMOUNT PAID FOR—METER RATE

A small family, keeping their plumbing in good repair, uses a very modest amount of water. Waste is very little.



AMOUNT WATER USED
AMOUNT PAID FOR—FLAT RATE
AMOUNT PAID FOR—METER RATE

A large family, also keeping their plumbing tight, might perhaps use twice as much.

AMOUNT WATER USED
AMOUNT PAID FOR—FLAT RATE
AMOUNT PAID FOR—METER RATE

But that same large family, if they were careless, could use a prodigious amount of water—perhaps four times as much if they let their plumbing get into disrepair and were not careful to turn off the water when they finished using it.

P. S. Experience has shown that on a metered basis, practically all this waste is eliminated.

NEPTUNE METER COMPANY • 50 West 50th Street, NEW YORK CITY

BRANCH OFFICES IN CHICAGO, SAN FRANCISCO, PORTLAND, ORE., DENVER, DALLAS, KANSAS CITY, LOUISVILLE, ATLANTA, BOSTON.
NEPTUNE METERS, LTD., 345 SORAUREN AVENUE, TORONTO, CANADA.

8

(Continued from page 14)

Wm. E. Stanley has been given a year's leave of absence from his position of Professor of Sanitary Engineering at Cornell University to permit him to take up the duties of Chief of the Sewerage and Incineration Group in the Office of the Quartermaster General, Washington, D. C. Prof. Stanley spent the past summer at Columbus, Ind., working on specifications and contract documents for the Southern Indiana Cantonment Project. Prof. Stanley is currently serving the Association as Chairman of Committee 7J—Distribution System Safety.

Frederick H. Stover, Chemist and Bacteriologist, Crescent Hill Filter, Louisville Water Co., Louisville, Ky., was called for active duty with the U. S. Army beginning October 19. He is stationed at San Francisco.

John A. Fulkman is serving as Water Supply Engineer for the Kansas Ordnance Plant at Parsons, Kansas. Mr. Fulkman is associated with Consoer, Townsend and Quinlan, engineering firm with headquarters in Chicago. Consoer, Townsend and Quinlan and Battey & Childs are Architect-Engineers for the Kansas Ordnance Plant.

(Continued on page 18)

American Water Works Association

62nd Annual Convention

Chicago - - June 21-25, 1942

MAKE YOUR RESERVATIONS NOW
BY WRITING DIRECTLY TO CHICAGO TO:

The Stevens Hotel

THE HEADQUARTERS HOTEL WHERE ALL
MEETINGS AND EXHIBITS WILL BE HELD.

Rates, fixed by the hotel management for the period of the convention, are:

Single room, per day	$3.00, $3.50, $4.00, $4.50
Double room, per day	4.50, 5.00, 6.00, 6.50
Double room with twin beds, per day	6.00, 7.00, 8.00, 9.00
Suite, per day	$10.00 and up

FOR BEST RESERVATIONS, WRITE NOW

CAST IRON PIPE

Manufactured in Sizes 2" to 96"—
A large stock constantly on hand,
facilitating prompt shipment.

Flanged Pipe

Special Castings

Flexible Joint Pipe

Bell and Spigot Pipe

Warren Spun Centrifugally Cast Iron Pipe

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PHILLIPSBURG, N. J.
EVERETT, MASS.

(*Continued from page 16*)

Report of the Rocky Mountain Meeting

The Annual Meeting of the Rocky Mountain Section was held September 18 and 19 at the LaFonda Hotel, Santa Fe, New Mexico. The total registered attendance was 84, with 26 wives attending. The Henshaw Cup percentage for the meeting was 51.1.

New Mexico's Governor Miles gave the welcoming address at 10:00 A.M. Wm. A. Peters, Rocky Mountain Section Chairman, presided and also gave a short talk on the importance of water works systems. Louis R. Howson, A. W. W. A. President, outlined in a very informative way the water works priorities situation. Mr. Howson cited the availability of chlorine on a first line priority basis for water treatment and stressed the need for returning chlorine containers promptly. He described the project rating application for instances where defense projects are creating new or special demands upon water systems.

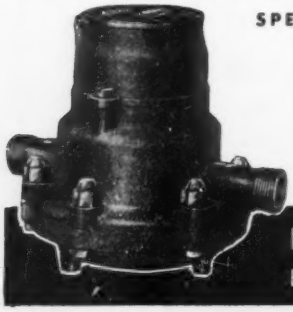
In an active discussion following, Mr. Howson was asked many questions about the details of priorities and supplies, and Del Porter, Chairman-elect of the Section, suggested that the Section might maintain an "Information Center" which would be an office with a filing system containing information on all available materials needed for water works systems. Chairman Peters said the Information Center might also establish a system of "Lend-Lease" of materials among municipalities. The idea would be to have from every water works system a list of materials which are not in use and which could be loaned until orders could be filled.

On the program was a paper, "Sabotage of Public Water Supplies," by D. A. Bryce, Special Agent, FBI. Discussions were by: Jack Davis, Eng. Asst., Colorado State Health Dept.; Ray C. Bollier, Water Supt., Alamosa, Colo.; and O. J. Ripple, Filtration Engr., Denver, Colo.

Stuart W. Akins, Electrolysis Engr. of the Denver Board of Water Comrs., spoke on "Cathodic Protection of Water Mains," with D. D.

(*Continued on page 20*)

FIRST QUALITY METERS EXCLUSIVELY



SPECIFY *American* or *Niagara*
(BRONZE CASE) (IRON CASE)
Water Meters
WRITE FOR CATALOG

BUFFALO METER COMPANY
Established 1892 2914 Main St., Buffalo, N. Y.

YORK, PA.
BEVERLY, N. J.
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PITTSBURGH, PA.
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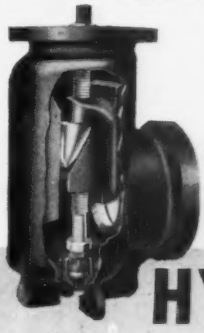
KANSAS CITY, MO.
GREAT FALLS, MONT.

QUICK WATER AT EVERY LUDLOW HYDRANT

The ability of Ludlow Hydrants to deliver quick water with *least possible shock* is one of the reasons why the cities mentioned above (a partial list) specify Ludlow.

The slide gate principle of hydrant construction, developed and perfected by Ludlow, assures these added advantages: proper drainage at the lowest point—no freezing; wedge-locked in closed position—no flooding; hydrant easily inspected and serviced without unscrewing anything below the ground level. Write for a free copy of Catalog No. 201 which fully describes Ludlow Hydrants and Water Works and Sewerage Equipment.



Ludlow Double Gate Valves

Big or little, the parallel seat double-disc type slide gate valve, developed and perfected by Ludlow, has been the universally accepted construction for water works valves for nearly three-quarters of a century.

LUDLOW HYDRANTS

THE LUDLOW VALVE MANUFACTURING CO., INC. • TROY, N. Y.

(*Continued from page 18*)

Gross, Chief Engr., Denver Board of Water Comrs., and Web Ballinger, Civil Engr., Grand Junction, Colo., discussing the subject. The Hatch, N. M., Water Supply was described by Charles N. Goldenburg, Cons. Engr., Santa Fe. John McGowan, Civil Engr. of Denver, gave a paper on "Well Water Supplies," with scheduled discussions by: L. A. Mather, Water Supt., Sterling, Colo.; George Blizzard, Water Supt., Lamar, Colo.; and Robert Portman, Sanitarian, Otero County Health Dept., La Junta, Colo. Jackson Brown, Engrg. Asst., Denver Board of Water Comrs., speaking on various aspects of metering, and Truman L. Dennis, Asst. Engr., Colorado Springs, Colo., leading a discussion, brought the first day's session to a close.

The second day's sessions began with Rufus Carter, Engr. on Dam Construction, Santa Fe, talking on "Masonry, Earth Fill and Arch Dams" and George M. Neel, Cons. Engr., Santa Fe, discussing the paper. Dudley Peters Glick, Bacteriologist, Colorado State College, Fort Collins, Colo., gave a paper called "Water Superintendent's Relationship to Other Local Public Health Activities." Discussions scheduled were by: Paul S. Fox, State San. Engr., New Mexico; L. O. Williams, State San. Engr., Wyoming; and B. V. Howe, State San. Engr., Colorado.

(*Continued on page 22*)

"STOP"

say

RUSTA-RESTOR TRADE MARK REGISTERED

PATENTED PATS. PEND.

to

RUST IN STEEL TANKS

Rusta Restor is the only positive method of preventing rust in all types of steel tanks and riser pipes (the electrical method)

RUSTA RESTOR CORP.

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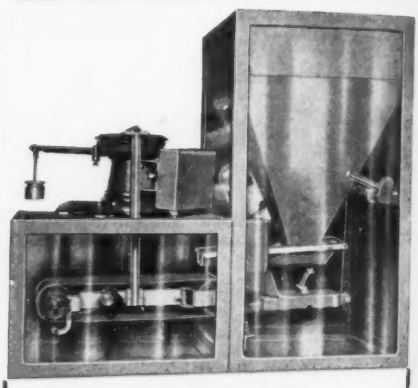


The accurate way to feed dry chemicals is *by weight*

SYNTRON

"Weigh-Flow"

Dry Feeder Machine

eliminates all guess work—and feeds exactly the right amount—by weight

SYNTRON CO.

428 Lexington Ave. Homer City, Pa.

STEEL PIPE *SCORES AGAIN!*

Unloading ARMCO Spiral Welded Pipe for a new water line in Cleveland. 50-foot lengths mean fewer sections to handle and fewer field joints.

Another recent Cleveland installation. Here ARMCO Pipe is being used for water circulation lines at the municipal light plant.

Cleveland Uses ARMCO Spiral Welded Pipe For Another Low-Cost Water Line

Once a city has experienced the benefits of ARMCO Spiral Welded Steel Pipe for supply and force mains, they are likely to reorder it again and again. Cleveland, the nation's sixth largest city, is a typical example. During 1940, as in previous years, this industrial center used ARMCO Pipe for important additions to its water supply system.

You can specify ARMCO "Spiral Welded" with confidence. Steel pipe has proved its durability, efficiency, economy in almost a century of service. Today, thanks to improved coatings, linings and manufacturing methods, an even better product is yours in ARMCO Spiral Welded Pipe.

With diameters from 6 to 36 inches, lengths up to 50 feet, and wall thicknesses for specific conditions, ARMCO Spiral Welded Pipe will meet every requirement. Consider its many practical advantages for that next job. Write today for prices and complete facts. The American Rolling Mill Company, Pipe Sales Division, 2231 Curtis St., Middletown, O.

ARMCO ARMCO **SPIRAL WELDED PIPE**

Steel Pipe . . . An Old Product Made Better • Meets AWWA Standard Specifications

(*Continued from page 20*)

Remainder of the schedule was: "State Aid to Municipal Utilities" by W. Carlos Powell, Mun. Engr., State Comptroller's Office, Santa Fe; "The Arch Hurley Conservancy District" by Harold Much, Res. Engr., Tucumcari, N. M.; and a panel discussion on water purification.

At the Business Luncheon the tellers' election report showed election of the following officers:

For Chairman: Del Porter, Water Supt., North Side Water Co., Pueblo, Colo.

For Vice-Chairman: George Nisbet, City Mgr., Palisade, Colo.

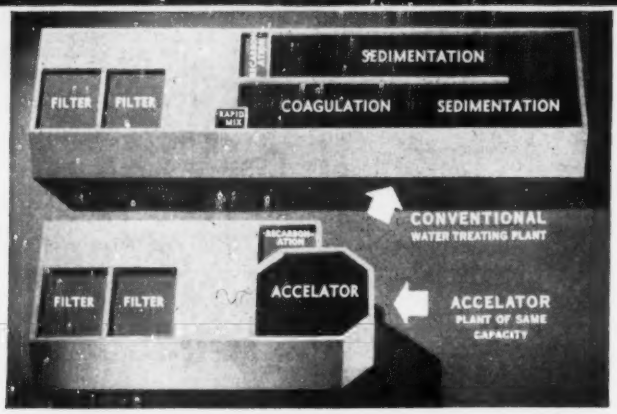
For Secretary-Treasurer: B. V. Howe, State San. Engr., Denver, Colo.

For Trustee: Clyde Dodds, City Mgr., Las Cruces, N. M.
Clifford Ward, Water Supt., Silver City, N. M.

The Secretary-Treasurer's report contained a description of the Water Works School held at Denver in February, 1941. This was the first short school for water works and it was hoped that the attendance would reach 25 or 30; consequently, it was very gratifying to have a

(*Continued on page 26*)

SAVE WITH AN ACCELATOR



The Accelator treats *faster*, delivers a better effluent, and *costs less to operate* than ordinary treating plants. Send today for the free bulletin, "The What, How and Why of the Accelator."

INFILCO INTERNATIONAL FILTER CO. INFILCO
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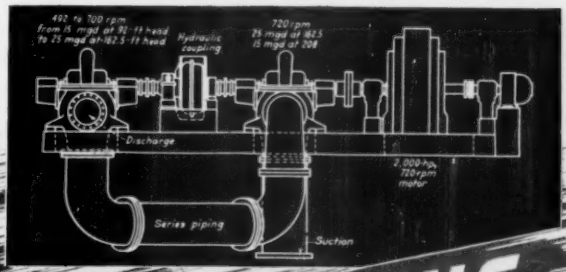
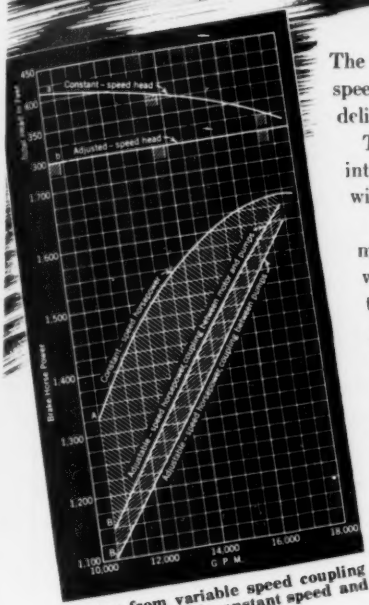


Variable speed coupling between pumps.

Variable SPEED COUPLING with DE LAVAL PUMPS saves power!



Saving from variable speed coupling as compared with constant speed and throttling.

The *head developed* by a centrifugal pump at constant speed is greatest at shut-off and *falls off* with increased delivery.

The *head required*, as, for example, when delivering into a piping system or when feeding boilers, *increases* with flow.

With De Laval turbine-driven pumps these requirements can easily be met by varying the speed, but with A.C. motor-driven pumps the alternative is throttling, which is wasteful of power. D.C. motors are expensive, while variable speed A.C. motors are uneconomical.

However, where two or more pump stages can be used, it is necessary to vary the speed of one pump only, as is done in the De Laval variable speed coupling arrangement here shown.

The loss from slippage affects only the power taken by the variable speed pump and is much less than the power that would be wasted by throttling a constant speed pump or by varying the speed of both pumps by means of a hydraulic or magnetic coupling to get the same flow and pressure relations in the discharge pipe.

The inter-pump coupling, of either the hydraulic or the electro-magnetic type, can be controlled manually or automatically to maintain the desired pressure conditions in the pump discharge line.

Write for Bulletin M-11, giving full particulars.

DE LAVAL Steam Turbine Co.
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(*Continued from page 22*)

registered attendance of 88. Many of those attending were water superintendents from small cities and towns who had never attended our Rocky Mountain Section Annual Meeting. It seems their town officials would not send them to a convention, but were interested and did send them to a water works school. A 50-page outline was mimeographed and given to each student to follow during the lectures, laboratory work, and field work at the filter plants. The course consisted of Elementary Chemistry, Bacteriology, Hydrology, Hydraulics, Water Works Equipment, Well Water Supplies, Filtration, Coagulation, and General Operation. A final examination was given to each student to take home, with the request to submit the answers to the Secretary within thirty days. This time was extended to sixty days, upon request. A Certificate of Attendance was mailed to all those attending the school, and a grade was given according to their accomplishments in the examination.

Director O. J. Ripple gave some interesting information from the Annual Meeting of the Board of Directors in New York and from the Toronto Convention.

Mrs. Miles, wife of the Governor, entertained the ladies at the Governor's Mansion at a breakfast, September 18. This, of course, was very

(*Continued on page 28*)

Economies in Office Forms
By Israel Rafkind

Recommended Practice for Distribution System Records
Committee Report

Coordinating Operating System Records With Accounting Records
By Nathan B. Jacobs

UNDER ONE COVER

These three documents, reprinted from the February, 1940, issue of the JOURNAL, constitute a basis upon which the head of any water department, whether it be large or small, may build an economical and practical system of keeping distribution records. The system recommended is wholly adequate, yet in no way burdensome. These outlines are compiled by authorities and should be in your hands today.—64 pp., $.25.

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(*Continued from page 26*)

much appreciated, and was mentioned in the Resolutions which were read at the Banquet.

On Friday evening, the banquet was held, with Governor Miles and Mrs. Miles attending. Chairman Peters presided and the Governor made a short and interesting speech. The new Chairman, Mr. Porter, was inaugurated and then presented the retiring Chairman with a gold pin, emblematic of being a Past Chairman of the Section.

B. V. HOWE
Secretary-Treasurer

Arthur B. Morrill, Engineer of Sewage Treatment, Detroit Department of Water Supply, has been granted a year's leave of absence beginning December 1, so that he may become a member of the Medical Commission to the Burma-Yunnan Railroad, serving as a Senior Sanitary Engineer (R) of the U. S. Public Health Service. The Commission will be engaged in control of malaria, sanitation of labor camps, and supervision of medical care for workers engaged in building a railroad in southwestern Yunnan Province, China.

Philadelphia's water and sewage situation received top-notch attention in mid-October: President Roosevelt wrote Federal Security Administrator Paul V. McNutt, asking for recommended ways and means for the Federal Government to help alleviate threats to defense work from fires and menaces to health from sewage dumping by Philadelphia in the Schuylkill River. Philadelphia has had for many months a staff of engineers planning improvements for its water supply and treatment. Also, a proposed $42,000,000 sewage disposal plan has been twice shelved by the Pennsylvania Supreme Court giving adverse decisions on proposals for financing the project. "Corrupt but contented" too long is one explanation of Philadelphia's dilemma.

(*Continued on page 30*)

Robert F. Mackie, Consulting Chemist and Engineer, Bradford, Pa., died recently at the age of 39, after having been ill for the past two years.

Born in Bradford, Mr. Mackie attended the local schools, then Massachusetts Institute of Technology from which he received his Master's degree in Chemical Engineering. He had had his own laboratory for the past eight years. Mr. Mackie was Vice-President and a Director of the Bradford Building and Loan Assn. He was active in the affairs of the New York-Pennsylvania Section of the American Chemical Society and was an Active Member of the A. W. W. A.

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Specifications for Pit Cast Cast Iron Pipe—A21.2

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(*Continued from page 28*)

F. W. Kittrell, who for the past eleven years has been connected with the Tennessee State Health Dept., is now Engineer-Secretary of the Interstate Commission on the Potomac River Basin, Washington, D. C.

Did you ever see a chlorine atom? Pennsylvania Salt Mfg. Co. has depicted the chlorine atom in finely printed color for the cover of its new 48-page chlorine bulletin (6th ed.). Excellently portrayed and described are the properties of chlorine, liquid chlorine containers, piping and fixtures for chlorine, water purification and other uses of chlorine, preparation of compounds, analytical methods, handling of chlorine leaks, and a review of chlorine specifications. The purification of chlorine is also described. Copies are available from the Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia.

The Foxboro Company, Foxboro, Mass., recently announced its new "Model 30 Stabilog Controller," an improved variation of an earlier marketed instrument, the first to provide full proportional control with automatic reset of the control point. Applications involving contro- of temperature, pressure, liquid level, or flow, are shown in detail in Bullel tin A-252 available upon request to the manufacturer.

(*Continued on page 32*)

SANITARY ENGINEERS

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(Continued from page 30)

Report of the Wisconsin Meeting

The Twentieth Annual Meeting of the Wisconsin Section was held October 6–8 at the Hotel Racine, Racine, Wis.

In the Wisconsin Section, no formal program is provided for the first Monday, the activities being confined to registration, a trip through the local water works and a pre-convention gathering, which this year was entertained by movies showing Racine's city facilities. Other movies were one showing Racine's noted Fourth of July parade and one showing the construction of the steel pipe and laying it for the recent improvements at Los Angeles. About 10:30 P.M. the gathering adjourned to a buffet luncheon.

Tuesday Morning, Oct. 7: President James W. Myers, Jr., of Kenosha, Chairman for 1941, opened the meeting shortly after 9:00 A.M. Racine's Mayor T. Gleason Morris welcomed the delegates. L. A. Smith, Secretary and Treasurer, presented brief summaries of the annual reports of these two offices. As a means of getting acquainted, an old fashioned roll call was held at which each person introduced himself.

Preston A. Reynolds, Rate Analyst, Public Service Com. of Wisconsin, outlined water main extension policies in three approaches: (1) in urban districts, mains laid by special assessment, (2) in urban districts, mains laid at expense of utility and the cost added to the rate base, and (3) in suburban areas, mains generally extended at expense of property served. Frank K. Quimby, Constr. Engr., Water Dept., Racine, gave a very interesting talk on Racine's mobile equipment—general service truck, portable generating unit, electrical thawing unit, portable air compressor with necessary tools, as well as special devices such as tapping materials, and pipe locators. Samuel A. Greeley, Cons. Engr., Chicago, outlined the precautions which might be taken in civilian protection in the fields of sanitary and public health engineering, drawing on the experience in England to show the methods of repairing mains, and obtaining adequate lighting. He especially urged that adequate maps of the distribution system be available for emergency field use.

After appointment of committees, a luncheon with 100 in attendance was held in the Rainbow Room of the Hotel Racine.

Tuesday Afternoon, Oct. 7: A. R. Colbert, Public Service Com., Madison, speaking on depreciation of water works, said he preferred the straight-line method because it built up reserves early in the history of the plant. He said depreciation rates of all water works utilities in Wisconsin had been checked and certified by the Commission. These rates average 1.25 per cent for all utilities, with composite rates varying from 0.8 per cent to 2.1 per cent, the majority being between 1.0 and 1.5 per cent.

(Continued on page 34)

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(*Continued from page 32*)

M. Starr Nichols, State Laboratory of Hygiene, Madison, called attention to the fact that there are, in every community, certain individuals who are particularly susceptible to copper and lead poisoning. He said that if copper and lead are used for service materials on any but the very softest waters, there is little danger, although he cited cases of poisoning in water supplies containing upward of 200 p.p.m. Otto Halverson, Engr., Milwaukee Water Works, gave the results of a corrosion study of bolting materials and coatings. He recommended the use of coal-tar enamel coatings and stated that muck, clay and cinders were all undesirable soils in which to lay mains. He recommended that consideration be given to backfilling with sand and the use of limestone or slacked lime. Joseph P. Schwada, City Engr., Milwaukee, gave a most interesting discussion of the planning and operation of elevated storage tanks. In Milwaukee, these tanks are used to supply the distribution system during the period of maximum pumping. He showed by charts how effective this system could be.

Wednesday Morning, Oct. 8: William U. Gallaher, Supt. of Water Works, Appleton, described the installation of a new softening plant at Appleton and other recent extensions and improvements including a storage bin for chemicals, settling basins, clear well and additional laboratory and office space. The cost was about $200,000.

Herbert Ihling, Field Engr. of Construction, and Rheinhold Klebnow, Supt. of Distribution, both of the Milwaukee Dept., discussed experiences in laying and repairing mains. On a recently opened highway in Milwaukee, duplicate lines have been laid under the curb on each side of the street. Several interesting methods were presented for removing water leaking from valves, etc., during main breaks. L. A. Smith, Supt., Water Dept., Madison, discussed the new 100,000-gallon elevated watersphere recently installed in Madison. He called attention to the fact that such elevated storage decreases friction loss, insures uniform pressure and provides a reserve for fire protection. Harry E. Jordan, Secy., A. W. W.

(*Continued on page 36*)

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(*Continued from page 34*)

A., outlined priority procedure under Order P-46 and on the project basis. He also cautioned members against selling material acquired through priorities.

The nominating committee presented the following list for the respective offices for the ensuing year: Jerome Zufelt, Supt. of Water Works, Sheboygan, Chairman; O. J. Muegge, San. Engr., State Board of Health, Madison, Vice-Chairman; Blaine Page, Supt., Water Dept., Shawno, Director; and L. A. Smith, Supt., Water Dept., Madison, Secy-Treas. The nominees were unanimously elected. Under Wisconsin Section procedure, James W. Myers, Jr., Kenosha, remains as a member of the Board for the ensuing year.

Walter A. Peirce, Mgr., Water Dept., Racine, was chosen for the Fuller Award for "conspicuous work in the reconstruction and management of the Water Utility at Racine, which work has been an incentive to all of us to improve our plants, and further, for the continued interest and effort which he has put forth in his furthering of the objectives of the A. W. W. A., particularly the Wisconsin Section."

Wednesday Afternoon, Oct. 8: Two sessions were held: the Purification Session at Kenosha and the Ground Water Supply Session in Racine.

(*Continued on page 38*)

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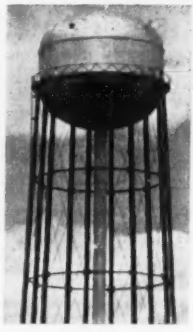

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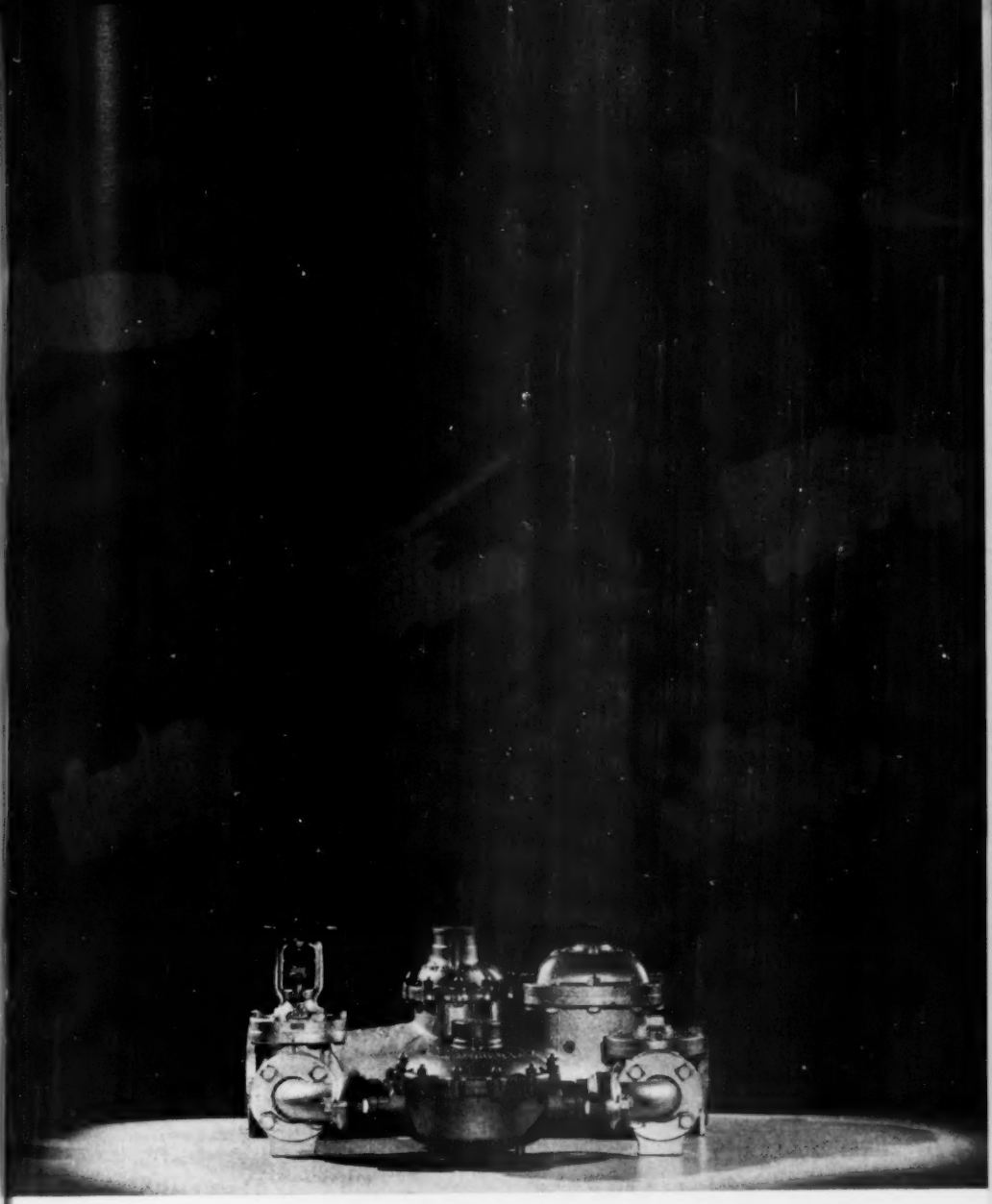

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(Continued from page 36)

The Purification Session led off with George Prindle, Water Dept., Highland Park, Ill., giving in detail the special problems of suburban water service. James Kerslake, Milwaukee Water Dept., outlined the experiences in operating the Milwaukee filter plant. John R. Baylis, Water Dept., Chicago, spoke on "Better Water Quality Standards for Inspiring Better Water Purification Plant Operation," which was followed by discussions on standards of purification and analysis in which Harry E. Jordan, James Kerslake, Dr. Bernard Domogalla and M. Starr Nichols participated.

At the Ground Water Supply Session, E. D. Brown, Supt. of Water Works, Eau Claire, told of using chlorine for removing algae growth from wells by putting 30 lb. into the well, letting it stand overnight, then pumping to waste until clear in the morning. Repeating this several times in each well restored wells, which had dropped from 2,100 gal. per min. to 1,500 gal. per min., to nearly original capacities. John Barth, City Engr., La Crosse, discussed restoration of well yields by inserting a packer in the pipe line immediately above the well screen, pumping hydrochloric acid through a 2-inch pipe below the packer, then pumping to waste until clear. La Crosse wells, which are pumped by direct suction, had the suction lift

(Continued on page 40)

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(*Continued from page 38*)

reduced from about 25 ft. to 12 or 15 ft., the quantity of water increasing more than 50 per cent.

Walter Steaffler, Supt. of Water Dept., Manitowoc, described the use of sulfuric acid for maintaining screened wells, citing results similar to those at La Crosse. Ralph E. Milaeger, Milwaukee, gave excerpts from his thesis prepared for the University of Wisconsin, showing that wells in the sandstone formations should be developed by shooting. He stated that in general this method produced wells of 50 per cent greater capacity and permitted obtaining more water with the same or less power. A lively discussion followed this paper, the general conclusion being that shooting wells was desirable if done by someone with proper equipment and experience. O. J. Muegge and L. A. Smith discussed the proposed A. W. W. A. Standard Specifications for Deep Wells and Deep Well Pumps.

The attendance at the meeting was in excess of 260, an all-time record.

L. A. SMITH
Secretary-Treasurer

"Factors Affecting the Germicidal Efficiency of Hypochlorite Solutions" by A. S. Rudolph and Max Levine is Bulletin 150 recently issued by, and available from, the Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa. The abstract reads as follows:

"The effects of temperature, concentration, and reaction (pH) on germicidal efficiency of calcium hypochlorite were studies by determining the course of disinfection and the time required to effect a reduction of 99 per cent in the number of viable spores of *Bacillus metiens.*

"The reaction, particularly in the alkaline range pH 8 to 11, markedly influenced germicidal efficiency of calcium hypochlorite, the higher alkalinity being distinctly less germicidal.

"Survivor curves indicated the existence of a lag phase in the rate of death (probably associated with penetration of the hypochlorite into the cells) followed by an increasing rate of death, which approached a constant. Doubling the concentration of calcium hypochlorite effected a reduction of 30 per cent in the time required to kill 99 per cent of the exposed spores of *B. metiens.* A temperature rise of 10°C. generally caused a decrease of 60 to 65 per cent in killing time.

"A technique was devised for the preparation of a bacterial spore suspension which remained quite constant in population and resistance to chlorine for a period of about 8 months and which should therefore be particularly useful for quantitative disinfection studies."

The anticipated shortage of steel which is being precipitated by the National Defense Program will be much less acute if wastes of this vital metal by antiquated processes are stopped by utilization of modern meth-

(*Continued on page 42*)

EDSON

DIAPHRAGM PUMPS

Hand Operated--sizes 2", 2½", 3", 4"
Power Operated--sizes 3" and 4"

Open Discharge or Force Pump
Skid, Truck or Trailer Mounted

COMPLETE PUMP OUTFITS

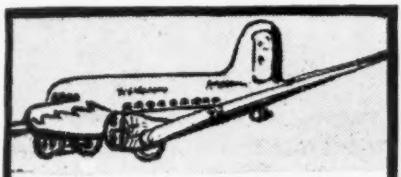
Edson Pumps - Suction Hose
Brass Couplings - Bronze Clamps
Red Seal Diaphragms
Brass Strainer or Foot Valve
Hose Spanners - Adapters - Etc.

Also—Brass Hydrant Pumps

THE EDSON CORPORATION

Main Office and Works: 49 D St., South Boston, Mass.

New York, 142 Ashland Pl., Brooklyn



On Guard

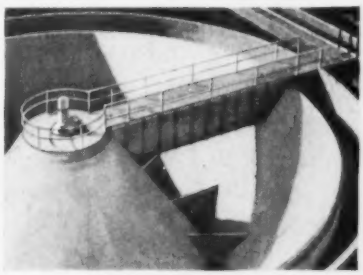
The municipality or private plant protected by Kupferle Fire Hydrants have on guard sentinels of precision manufacture with a record of more than a half century of unfailing performance.

Specification Sheets on request.

JOHN C. KUPFERLE
FOUNDRY COMPANY
ST. LOUIS

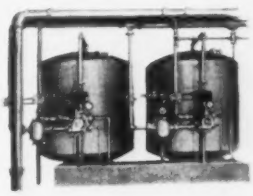
KUPFERLE
FIRE HYDRANTS

Two easy ways to get SOFT WATER for your city—



Permutit* Spaulding Precipitator

This new cold lime "Precipitator" treatment takes only half the space of old-type plants, makes bigger savings. Now handles capacities as high as 120,000,000 gallons daily.



Permutit Zeolite Water Softener

This simple method is fully automatic, does not even require a skilled operator. Available in a wide range of models and sizes. Ample stocks of Permutit Zeolites available for immediate delivery.

FREE BOOKLETS and advisory service. Address: The Permutit Company, Dept. G2, 330 West 42nd Street, New York, N. Y.

* Trademark Reg. U. S. Pat. Off.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

(*Continued from page 40*)

ods of manufacture, fabrication and construction, according to the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.

Figures just released by the Foundation show that an average of 18 per cent less steel is required to build the welded product or structure than the same one riveted.

On this basis, production for National Defense would have 360 lb. more usable material in every ton of steel. Applied to the nation's annual ingot capacity of 82,000,000 tons, this would conserve 2½ month's production each year.

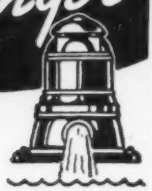
The actual percentage of steel savings in the Foundation's 15 case examples, which were taken at random from industrial reports, range from 9 per cent on a field service truck body and freight car underframe up to 45 per cent on a scroll case for a turbine.

On the 10,490-pound freight car underframe, welded construction saved 1,020 lb., or sufficient to produce one *extra* underframe for every 10 frames produced.

Chain Belt Company, Milwaukee, has announced the appointment of A. W. Thomas as Sales Manager of the Construction Machinery Div.,

(*Continued on page 44*)

Built to Serve Longer



Every part of a Layne Well Water System will stand the heaviest duty; the hardest grind and longest non-stop runs. They are built to stand up—and give you far more than might be expected. Dollar for dollar they will pay greater dividends. Write for Catalogs, Folders and Bulletins. No obligation. LAYNE & BOWLER, INC., Memphis, Tenn.

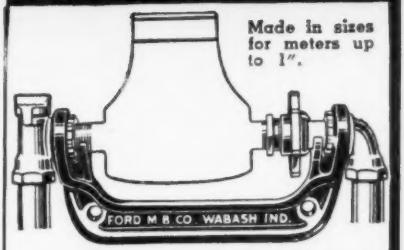
LAYNE WELLS & PUMPS

FORD YOKES

FOR RISER SETTINGS .. FOR ANGLE SETTINGS .. FOR LINE SETTING

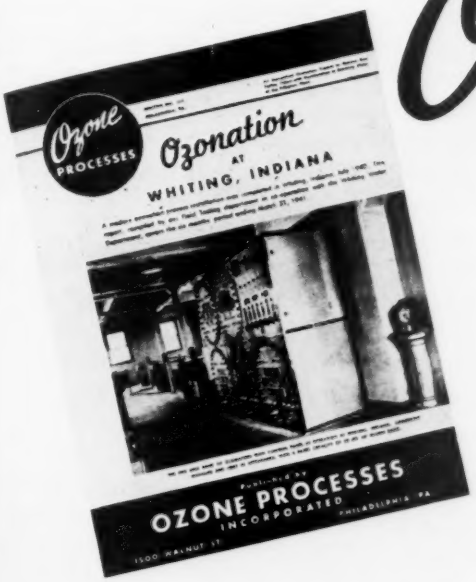
MAKE EASY METER CHANGES

Made in sizes for meters up to 1".



Ford Yokes connect inlet and outlet service pipes permanently and make easy, trouble-free meter changes. May include an inverted ground-key angle valve at the meter inlet. Made for all types of piping connections. Hundreds of thousands in service. Further information for the asking.

The Ford Meter Box Co.
WABASH, INDIANA



Ozone

FACTS YOU HAVE BEEN WAITING FOR

It took realistic American engineering to recognize that the best and real function of ozone in water purification is to remove taste and odors with sterilization as a plus value.

The complete story of ozone's great success in this capacity is told in our Bulletin No. 104.

Be sure to write for your copy.

OZONE PROCESSES
INCORPORATED
1500 WALNUT STREET
PHILADELPHIA

Ozone Processes, Incorporated, is an operating member of a well-established and soundly financed group, which has been serving American industry for over 60 years. The management is experienced and keenly aware of its responsibility to the Water Works Industry. This explains the thorough research and skilled engineering supporting every move we make in this field.

(*Continued from page 42*)

D. A. Kalton as Assistant Sales Manager and A. J. Frank as Assistant to the Manger of the Division. G. K. Viall was recently made head of the newly organized Division of Research and Development, which embraces all divisions of the company's business.

Dual power pump drives have been developed by the Peerless Pump Co. Normally equipped with electric motor head, the secondary drive may be by right angle gear, powered by gas, gasoline or diesel engine or steam turbine. Other types of dual drive pumps have steam turbines as primary power, with internal combustion engines connected with the secondary right angle gear. Details may be obtained from the Peerless Pump Company, 301 West Avenue 26, Los Angeles, Calif.

Everson Mfg. Co., Chicago, makers of Everson SterElators and other water sterilizing and filtering equipment, have announced a new portable chlorine gas SterElator of military type. It is mounted on a pneumatic tired trailer and is complete with manually operated sterilizer, self-priming pump, intake and outlet hose and racks for four standard high pressure drums of chlorine.

Compensation for well drillers is delineated in a recent decision rendered by the Supreme Court of South Carolina, described as follows in the September issue of *The Driller:*

"Two drillers undertook to deepen a well on a farm owned by a cotton mill company, and they were practically blinded by a dynamite explosion in the well. The South Carolina Workmen's Compensation Commission allowed awards in favor of both drillers against the company and its insurance company. That ruling assumed that the men were injured in the course of employment in the business of the company, and that, therefore, the case came within the provisions of the Workmen's Compensation Act.

"On appeal by the insurance company, the Supreme Court decided that the facts of the case did not bring it within either the Workmen's Compensation Act or the liability policy issued by the insurance company

(*Continued on page 46*)

Edgar Whedbee, Sanitary Engineer for the Water Works Dept., Dallas, Texas, died late in September at the age of 63. Mr. Whedbee had served in that capacity for the Dallas Water Works Dept. for the past fifteen years. He had been an Active Member of the A. W. W. A. since 1926.

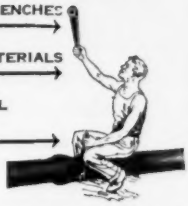
3 *Money, Time and Labor Saving Features of*

UNIVERSAL CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.



For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

Dept. C
THE CENTRAL FOUNDRY COMPANY
386 FOURTH AVENUE, NEW YORK, N. Y.

Gentlemen: Send us information and catalog on UNIVERSAL CAST IRON PIPE.

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For Underground Service Lines

ANACONDA COPPER and RED-BRASS

Anaconda Copper Tubes in straight lengths and coils... Anaconda "85" Red-Brass in straight lengths only – both are products of dependable quality. Made by the world's largest and most experienced manufacturer of copper and brass, and stocked by leading supply houses.

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THE AMERICAN BRASS CO.
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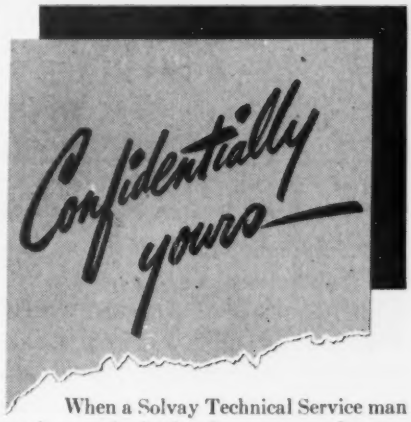

When a Solvay Technical Service man receives an invitation from you, perhaps so that you may obtain an outside viewpoint on a problem which has proven particularly difficult to solve, it is sometimes necessary to supply him with information of a confidential nature.

. . . That is a point on which some customers might hesitate to avail themselves of Solvay Technical Service. Let us reassure you . . . .

Any information you may impart to a Solvay Technical Service man *remains strictly confidential*. It is used only insofar as it is necessary to help solve your problem. When consultations are concluded, your problem is a closed book with Solvay Technical Service.

You will find on the staff of Solvay Technical Service men of the highest type who have been especially trained to cope with your problems as they pertain to alkalies and related products. They are at your service. Please call on them without hesitation.

60th ANNIVERSARY 1881 • 1941

SOLVAY SALES CORPORATION
Alkalies and Chemical Products Manufactured by The Solvay Process Company
40 RECTOR STREET NEW YORK, N. Y.

BRANCH SALES OFFICES:
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PLANTS LOCATED AT:
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SOLVAY
TRADE MARK REG. U. S. PAT. OFF.
TECHNICAL SERVICE

COOK Well Strainers

A reciprocal relation, the life and functioning of the one depending much on the other.

A. D. COOK, INC.
Lawrenceburg - Indiana

COOK Deep-Well Turbine Pumps

(*Continued from page 44*)

to the mill company. It did not appear that the well was to be used in the mill's operations, but rather that it was to be used by a tenant cropper to whom the mill company had rented part of the land. The court said that drilling of the well was not related to the business of the mill company, manufacturing textiles. However, because the company did not appeal from the decision of the Commission it remained 'stuck' for the awards made in favor of the drillers, while the insurance company, which successfully appealed, was released from liability.

"It is not to be overlooked that whether a well driller is an 'employee' of the party for whom a job is done or is an 'independent contractor' is a vital factor in determining whether or not he is entitled to an award on being injured while doing the work. In the ordinary case, where the driller contracts to sink a well at a fixed price—whether lump sum or by the foot—and is responsible to the owner only for results, and where the driller is his own boss, hiring and firing such help as he needs, he is an independent contractor. In that case, he is not entitled to an award under a workmen's compensation act for injury sustained in performing the contract. But, if the driller is hired by the landowner to drill a well under the latter's control and directions, he will be regarded as an 'employee,' and as such will be entitled to an award, if the nature of the employment is otherwise such as to bring the case within the workmen's compensation law of the particular state. In this case, the court seems to have assumed that the drillers were 'employees' of the mill company, and not 'independent contractors.' But, as above noted, the accident did not come under the South Carolina compensation law, because it did not occur in connection with the company's factory operations."

"Lubriplate" for lubrication in sanitary engineering is the subject of a detailed, illustrated issue of "The Lubriplate Film" issued by Fiske Brothers Refining Co., 129 Lockwood St., Newark, N. J.

Trade Mark MABBS Reg. U. S. Pat. Off.

PREVENT WEAR AND CUTTING of rods, plungers and shafts by using

MABBS RAWHIDE PACKING

on your Water Works and Sewage pumps and valves. Practically antifrictional, it saves enough in POWER to pay for itself in a short time. For over 45 years Mabbs Rawhide Packing has proven its superiority over other packings for these purposes.

Why not use it in your plant and benefit thereby?

MABBS HYDRAULIC PACKING COMPANY, *Inc. 1892*, 431 S. Dearborn St., Chicago, Ill.

News of the Field

The Federal Bureau of Investigation is not only adequately protecting the people of this country against spies and saboteurs, but under the leadership of John Edgar Hoover, its Director, it is giving the fullest co-operation to civilian groups who wish to be trained for defense of services such as public water supply.

In mid-November, the press carried releases indicating that the F.B.I. would within the next six months conduct "civilian defense training schools" in 260 cities in the U. S. Immediately, a letter was addressed to Director Hoover, saying in part:

"This program is of great importance to the executives of the many public water supply systems in the country and to the state sanitary engineers in the forty-eight states.

"I earnestly recommend that you authorize the attendance of responsible water works executives at these schools. It will serve greatly to guide them in the protection of their plants—it would be a step in the public interest."

The following reply was received:

FEDERAL BUREAU OF INVESTIGATION
UNITED STATES DEPARTMENT OF JUSTICE
WASHINGTON, D. C.

November 26, 1941

Mr. Harry E. Jordan
Secretary
American Water Works Association
22 East 40th Street
New York, New York

Dear Mr. Jordan:

Reference is made to your letter dated November 15, 1941, regarding the interest of the executives of responsible water works organizations in attending the Six-day Civilian Defense Courses being conducted by this Bureau in 260 cities in the United States. In keeping with your request, a communication has been addressed to the Special Agents in Charge of the various field offices of this Bureau advising that representatives of various public service agencies, including water works organizations which render services to a municipality, a county or a state, may be admitted to these courses, and in fact, that invitations may be extended to the mayors

(*Continued on page 2*)

(Continued from page 1)

and appropriate officials of county and state for the attendance of such officials at these courses.

I am very glad to learn of your interest and I appreciate your calling to the attention of the members of your association the fact that these schools are being conducted. I am very glad that it has been found possible for their admittance to these courses, and trust that this instruction will be of benefit to them.

With assurances of best wishes,

Sincerely yours,

(signed)

J. Edgar Hoover

All Section Chairmen, Secretaries and Directors and all State Sanitary Engineers were advised on November 29 that the way had been cleared for Sanitary Engineers and water works executives to participate in these training schools. This is a fortunate development, for which water works men should credit Director Hoover, who has shown himself fully co-operative with them and their interests on behalf of public water supply.

A decrease of 60,000 tons of chlorine for use in the pulp, paper and paperboard industry is expected to be effected by an order of November 15 by the Director of Priorities. The result will be less whiteness in practically all grades of paper, but the change will be noticeable only upon close inspection.

Among the uses of chlorine in defense production are: manufacture of plastics for degaussing cable used to make ships immune to magnetic mines; manufacture of waterproofing paraffins for canvas; as a solvent in armament plants; manufacture of guncotton; as a coolant for liquid-cooled airplane engines; manufacture of non-freezing dynamite; and in chemical warfare.

An exception is made for the use of chlorine to control bacteria for slime control or sanitary purposes in paper manufacture. Also the use of chlorine as a processing agent, not as a bleaching agent, is permitted to the same extent as it was used for each ton of pulp produced during the three-month period ending July 31, 1941.

(Continued on page 4)

Robert F. Brown, Constr. Engr., California Water Service Co., San Jose, Calif., was killed in an automobile accident on October 28 while driving from Capitola to his place of business in San Jose. He was very active in the affairs of the California Section and had served as Chairman of that Section in 1937.

WHERE TUBERCULATING WATERS MUST BE TRANSPORTED

(LESS THAN 25% OF THE U. S. A.)

USE LINED CAST IRON PIPE*

THE areas of the United States where tuberculating waters materially affect the carrying capacity of pipe represent *less than one-quarter of the total area of the country*. If you are located within one of these areas, use *lined* cast iron pipe. You do *not* have to sacrifice the long life, low maintenance cost and salvage value of cast iron pipe in order to be assured of high carrying capacity throughout the life of the pipe you buy. The Cast Iron Pipe Research Association recommends *lined* cast iron pipe where tuberculating waters must be transported. Lined cast iron pipe is the only pipe that will have 100 years of useful life plus 100 years of high carrying capacity. Send for map which shows approximately 76% of the country where little or no tuberculation is to be expected. Lined cast iron pipe is made in sizes from 1¼ to 84 inches.

**Various types of linings are available to meet various conditions and preferences of users.*

CAST Q IRON

Look for the "Q-Check" Registered trade mark.

The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 1015 Peoples Gas Building, Chicago, Illinois

CAST IRON PIPE

PUBLIC TAX SAVER NO. 1

(*Continued from page 2*)

True Davidson

Miss True Davidson, Deputy Secy., The Public Util. Com., Streetsville, Ont., should be added to the growing list of A. W. W. A. water works women. She attended the Toronto Convention as the official representative of Streetsville and is currently serving as Deputy Secy., while her predecessor, Capt. J. W. Drennan, is serving as Paymaster of the Lorne Scots, No. 1 General Holding Unit, Canadian Army Overseas.

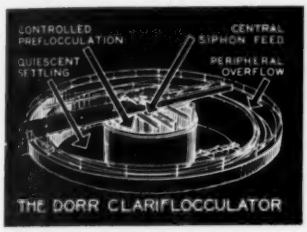
At 20, after having majored and graduated with honors in English, Miss Davidson took a position as principal of a Public and High School and taught Physics, Chemistry, Agriculture, General and Household Sciences. She forsook the field of education a year later for the employ of J. M. Dent & Sons Ltd., publishers. A year later, she was serving as educational manager for the publisher, arranging for authorization of textbooks in the Canadian provinces and visiting the head offices in England. Next she spent a year and a half as a free lance writer, producing stories, poetry, articles and children's stories.

Miss Davidson next spent seven years ghost-writing and directing a large-scale historical research project for Wm. Perkins Bull, formerly of London and Chicago. Much of the historical research centered about the County of Peel in Ontario, of which Streetsville is a historical center, and so Miss Davidson came to settle there.

(*Continued on page 6*)

Howard A. Dill, for many years Supt. of Water Works at Richmond, Ind., died recently in Richmond. He was one of Indiana's most active water works men, having been one of the group which organized the Indiana water works men as an independent group in 1908, before the days of A. W. W. A. Sections. He had been a member of the A. W. W. A. since 1900. He served on the Executive Committee in 1906–10, was a Director in 1938–40, and received the Fuller Award in 1939. He had retired about two years ago from service with the American Water Works and Electric Co.

FLOCCULATION + SEDIMENTATION = DORRCO CLARIFLOCCULATOR



CLARIFLOCCULATOR ADVANTAGES

IDEAL FEED DISTRIBUTION
Centrally, below the surface through an inverted siphon.

FLOC CONDITIONING
Mechanically, in a central circular compartment.

RETENTION FLOC STRUCTURE
Heavy dense flocs, once formed, are not disintegrated as they pass gently at low velocity into outer sedimentation zone.

IDEAL SETTLING CONDITIONS
Mechanically, in an annular zone with gradually decelerated flow, along radial lines to an overflow weir of maximum length.

SEEDING BY RECIRCULATION
A portion of the well-formed floc may be continuously returned to the flocculation zone to act as nuclei for seeding new floc formation.

A 2 IN 1 UNIT FOR TURBIDITY REMOVAL

* The Dorrco Clariflocculator provides in a single structure two essential steps in turbid water treatment—mechanical flocculation and mechanical clarification.

A glance at the advantages cited at the left will show how well these two steps have been teamed together for a balanced plant operation on turbid and colored water.

Objectionable, taste-producing sludge is removed mechanically so rapidly that it doesn't have a chance to impair the quality of the treated water.

• *Why not write today for our Clariflocculator bulletin, complete with drawings, operating data and design details?*

The DORR COMPANY Inc.
ENGINEERS · 570 LEXINGTON AVE. · NEW YORK
ATLANTA TORONTO CHICAGO DENVER LOS ANGELES

(*Continued from page 4*)

"5 Keys to Welding Wisdom" is a booklet issued by the James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland, Ohio. It describes books of practical and comprehensive coverage of various phases of welding.

J. Moran Roberts is now Asst. Mgr., Municipal Engineering Dept., Robert and Company, Inc., Atlanta, Ga. He formerly was City Engineer of Dublin, Ga.

David W. Carmichael, formerly Engr. and Supt., Water Dept., Hawthorne, N. J., is now serving as Director of Public Utilities at Verona, N. J.

Toronto's new duplicate water purification plant was put into service on November 1. Completed for some time, the plant was kept idle until exceedingly heavy pollution loads experienced at the Island Filters prompted the Council to open the new plant immediately. The city's

(*Continued on page 8*)

M H

HIGH QUALITY
VALVES
HYDRANTS

M & H products, including pipe line accessories, are well known for high quality of material and expert workmanship. They are made according to standard specifications and have been used for many years throughout the country. Write for Catalog No. 34. Address M & H Valve and Fittings Company, Anniston, Alabama.

LAMOTTE POMEROY SULFIDE TESTING SET

This outfit was developed for the accurate determination of Total Sulfides, Dissolved Sulfides, and Free Hydrogen Sulfide in Air and Gases. The methods of testing employed are those of Dr. Richard Pomeroy, with whose cooperation the apparatus has been developed. Outfit comes complete with necessary reagents, pipettes, glassware and full instructions.

Write for further information

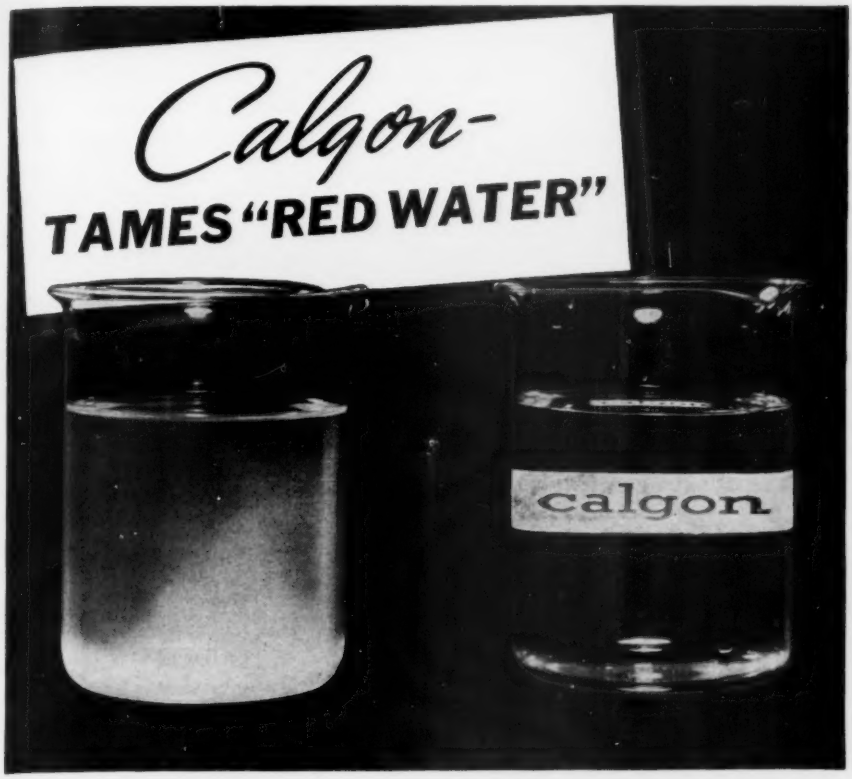
LaMotte Chemical Products Co.
Dept. AWA Towson, Baltimore, Md.

FILTER SAND

99 Per Cent Pure Silica
Washed, dried and manufactured to your specifications

Write for Prices on Bulk, Carload or Bags

Dawes Silica Mining Co.
Thomasville, Georgia



HERE'S a simple experiment that will show you how a few parts per million of Calgon will prevent the precipitation of dissolved iron.

The water in both beakers contains 20 ppm. of iron (as Fe), but the one at the right also contains 20 ppm. Calgon. And what a difference that makes!

In a few minutes the untreated water was discolored and within a few hours showed a voluminous precipitate of iron oxide. The water containing the Calgon was still clear after 48 hours, even though the water was exposed to the air all this time.

That's how Calgon works in your water system. You can prevent "red water" due to dissolved iron easily and quickly—and the Calgon Treatment is effective to the extreme ends of the lines.

In previous advertisements in this series we have stressed the ability of a few ppm. of Calgon to prevent "red water" resulting from corrosion. Calgon Treatment will also prevent "red water" due to the oxidation and precipitation of dissolved iron from well water, whether due to exposure to air or to chlorination. This has been conclusively proved in many cities during the past two years.

So, whether your "red water" is due to dissolved iron or corrosion, you can clear it up with Calgon.

Write us for a sample of Calgon and full details on how to make this interesting experiment. We'll also gladly furnish complete technical information on Calgon* and its possible usefulness in the treatment of your supply. Just mail the coupon.

Calgon is the registered trade-mark of Calgon, Inc. for its glassy sodium phosphate products.

calgon, inc.
300 ROSS ST PITTSBURGH PA

Calgon, Inc.
300 Ross St., Pittsburgh, Pa.

Please send literature on Calgon Treatment for controlling "red water" due to ☐ corrosion ☐ dissolved iron.

Name.....

Affiliation.....

Address.....

City..... State.....

(Continued from page 6)

sewage enters the lake about midway between the intakes of the two plants. The city plans to operate both the old and new plants and thus draw more heavily upon the better supply as it prevails at either intake.

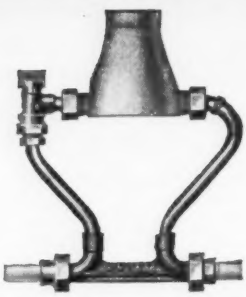
"Employee Training in the Public Service" and **"Public Relations of Public Personnel Agencies"** are two books recently issued at $2.50 each by the Civil Service Assembly, 1313 East 60th St., Chicago, Ill.

The Eighteenth Annual Water and Sewage Short Course for Oklahoma will be held January 19–23 at Oklahoma A. and M. College, Stillwater, Okla., under the direction of the Department of Civil Engineering of which Prof. Edward R. Stapley is Acting Head.

A demonstration of emergency water purification—as it might have to be carried out to protect New Yorkers from water-borne disease in the case of damage to the water system from bombs, explosion or sabotage—was carried out recently before prominent officials of New York City's Department of Water Supply, Gas and Electricity, in Battery Park, New

(Continued on page 10)

The Coppersetter
. A COMPLETE METER MOUNTING



The COPPERSETTER is a simple, convenient and durable fitting for installing water meters in horizontal service lines. It is all brass and copper, made in several heights and can be provided with an inverted ground-key angle valve at the meter inlet. Write for more information about the COPPERSETTER.

The Ford Meter Box Co.
WABASH, INDIANA

3 Money, Time and Labor Saving Features of
UNIVERSAL
CAST IRON PIPE

LAID WITH ONLY WRENCHES

NO CAULKING MATERIALS

NO GASKETS. NO BELL HOLES TO DIG.

For water supply, fire protection systems, sewage disposal systems, industrial, and irrigation. Flexible.

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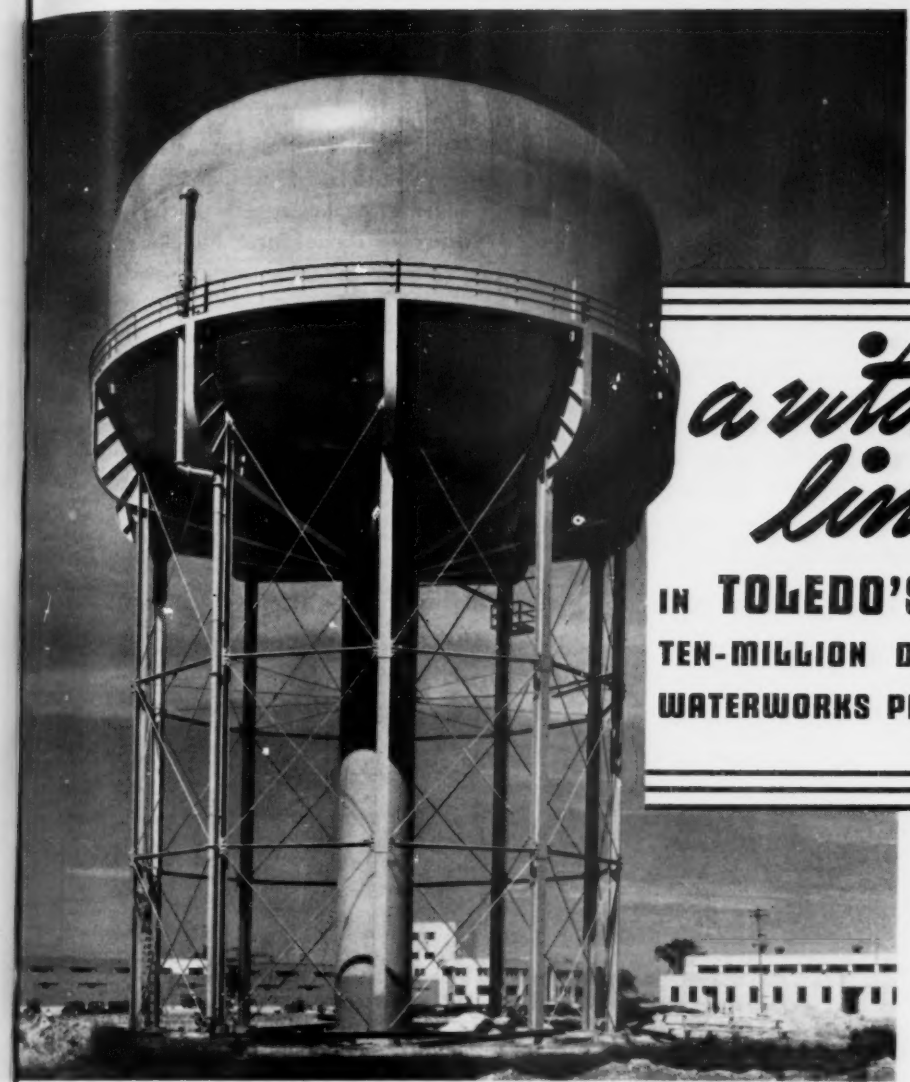

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(*Continued from page 8*)

York City. The equipment used for this demonstration consisted of the new trailer-type mobile chlorinating unit recently developed by Wallace & Tiernan Co., Inc., Belleville, N. J. The unit has special facilities for hooking up to broken mains, etc. Many of its features have been incorporated as a result of experience gained in safeguarding water in "blitzed" English cities.

Report of the Michigan Section Meeting

The usual interest in the water works field was displayed again at this meeting at Grand Rapids, September 24–26. After the call to order on Wednesday morning, Mayor George W. Welsh gave the "Welcome to the City," then R. J. Faust, Asst. Engr., State Dept. of Health, gave his welcome, perennial "News of the Field."

News of the Field in Michigan—R. J. Faust

Less than a third of the 362 water works in the State will be concerned with the Certification requirement contained in the licensing bill passed by Michigan's state legislature, for only those filtering and chlorinating

(*Continued on page 12*)

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(Continued from page 10)

are affected. In the state there are 50 plants both filtering and chlorinating and 51 chlorinating without filtering. These serve over three million persons, while 261 plants pumping well water and not treating serve a half million people. There were 102 certified operators in the State in June. (For the pertinent text of the bill, see p. 16, September 1941 JOURNAL News of the Field.)

A five-day supply of raw water in storage basins saved Bay City a year ago, when on November 11 a 60-mile wind took the water out of Saginaw Bay away from the intake for 26 hr. Pinconning, according to Philip Helmer, was not so fortunate when its intake was out of water for 34 hr. and consequently the water system devoid of water for 16 hr. after storage was exhausted. Four 120-foot sections of the new Grand Rapids intake in Lake Michigan were forced out of place, two of the sections remaining at right angles to the intake and the other two being carried away completely. A temporary intake was established just inside the break about 300 ft. off shore.

A cross-connection at Frankenmuth was discovered when tap water at the filtration plant showed brown, like river water. A local brewery

(Continued on page 14)

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The FIRE HYDRANT with Extra values

Extra Convenience

The Kennedy SAFETOP can be lengthened for change in street grade without excavating or shutting off the water supply, its nozzles can quickly be made to face exactly any desired direction, and all operating parts are readily accessible.

Extra Economy

Repairs to a Kennedy SAFETOP broken in a smashing collision require only a standpipe breaking ring and a stem coupling costing $6.00. These parts can be installed in less than half an hour by one man, without excavating or shutting off the water supply. Other SAFETOP economy factors are the long-wearing valve and gasket materials, and the sturdy operating mechanism.

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Large standpipes and inlet valves, carefully shaped entrance elbow, bell-shaped nozzles, and absence of obstructions through the hydrant combine to minimize friction loss and to assure practically full main pressure at the nozzles. In addition, the simple straight-line mechanism assures easy operation.

Extra Safety

When struck by an impact which *no* hydrant could withstand, the Safety Breakable Section of the Kennedy SAFETOP parts cleanly, and no flooding can occur. Occupants of the colliding vehicle are protected from likelihood of severe personal injury, and the neighborhood is protected from damage by water or lengthy delay in returning the hydrant to service.

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KENNEDY
SAFETOP FIRE HYDRANT

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(Continued from page 12)

was known to be pumping raw river water but no brewery cross-connection was known. Inspection showed the brewery service meter to be going backward at the rate of 7 gal. per min. Later the cross-connection was found and broken. The system was flushed free of all unsafe water and water bearing 50 p.p.m. chlorine pumped in from the plant. The County Health Dept. wrote all Frankenmuth families and consequently 500 of the 1100 population were inoculated against typhoid. From 7,000 to 12,000 gal. of raw river water were pumped into the town system, yet there was no outbreak of disease. The obvious turbidity of the water in the system probably prevented much consumption that might have led to disease.

The necessity of never easing up in maintaining personnel, equipment, and a safe water supply in this country's "all-out" defense and aid to Britain was elaborated upon by V. H. White of the Michigan Defense Council and by Lieut. Harold Mulbar of the Michigan State Police Dept. Loring F. Deming, Asst. Engr., Michigan Stream Control Com., described the long range policy generally in effect but admitted the taking of tem-

(Continued on page 16)

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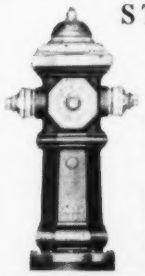

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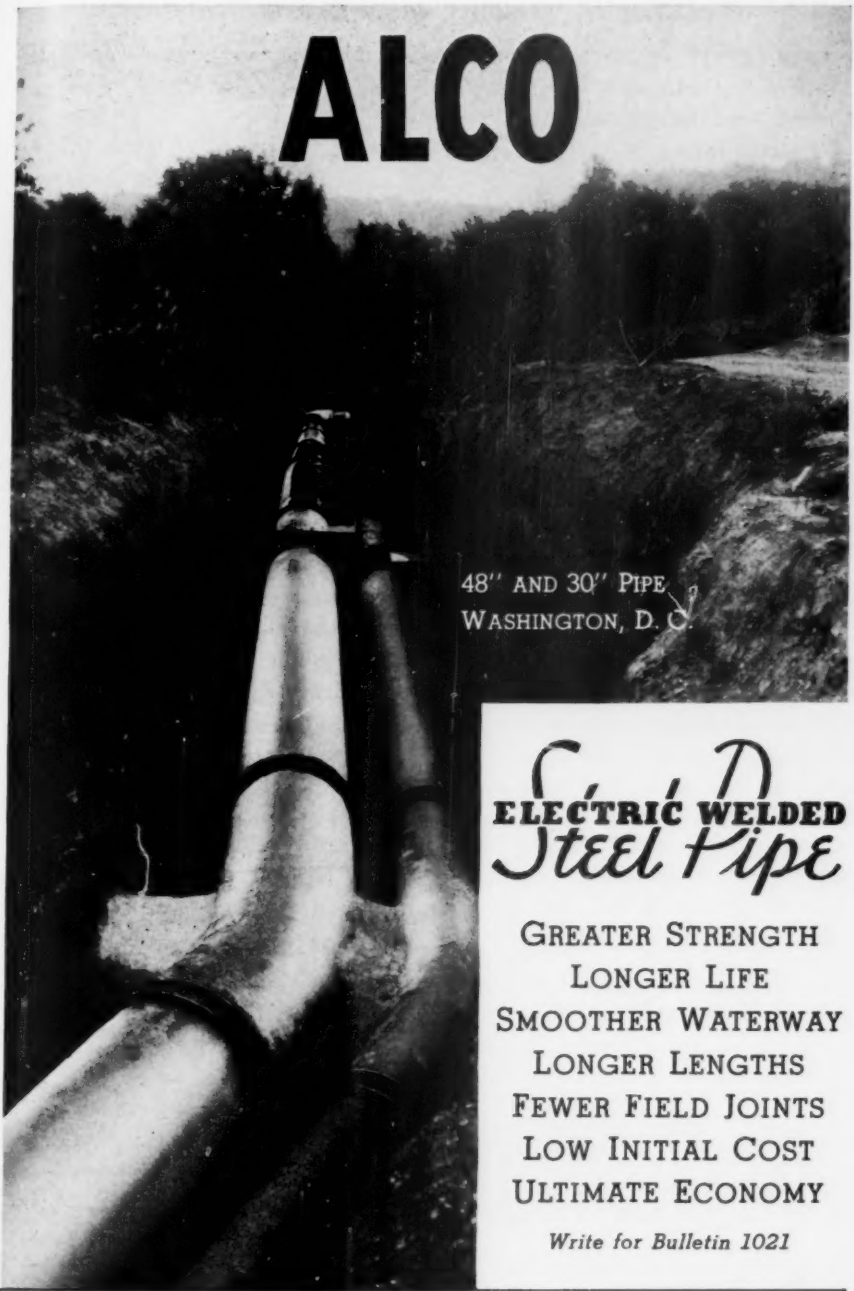

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(Continued from page 14)

porary emergency steps in major defense areas to get approved water supplies and dispose of human wastes. In discussion, W. M. Wallace and George Golden raised questions about the plan to drain the area northeast of Detroit into Lake St. Clair above the Detroit intakes. John Hepler, Director of the Bureau of Eng., State Dept. of Health, set forth what is being done to divert this sanitary drainage to the Detroit sewage or other systems.

Arthur P. Kuranz gave a paper on Thursday morning on "Meter Maintenance Practice," and Alfred Eckert discussed the subject. W. Sears Herbert spoke on "Water Rate Structures" with L. E. Ayres giving a discussion.

Louis B. Harrison completed the afternoon program with a review of "Proposed Standards for Purification Plant Operation" which were submitted for discussion to the A. W. W. A. at the Toronto Convention. Mr. Harrison read parts of the Proposed Standards which appeared controversial in view of practices at different plants in Michigan. Because further study of the Proposed Standards seemed likely to be fruitful, Paul Stegeman made the resolution that Chairman McQueen appoint a committee to assist Mr. Harrison. Consequently the following were appointed: Paul Stegeman, Sidney DeBoer, R. J. LaMarre, and J. C. Richardson.

As a part of the Michigan Conference on Water Purification, Col. Edward Rich of the Engineering Bureau introduced Dr. H. Allen Moyer, Comnr. of the State Dept. of Health, who gave an appeal for efforts even greater than the praiseworthy work already done by water works men. Dr. W. L. Mallman of Michigan State College summarized the collaborating work of laboratories in U. S. and Canada on parallel plantings using standard lactose broth as opposed to lauryl sulfate tryptose broth. The work is still in progress and tubes confirming in only one media are being sent to Dr. Mallman for identification. Dr. Mallman is serving as Chairman of the A. P. H. A. Committee on Standard Methods for the Examination of Water and Sewage.

(Continued on page 18)

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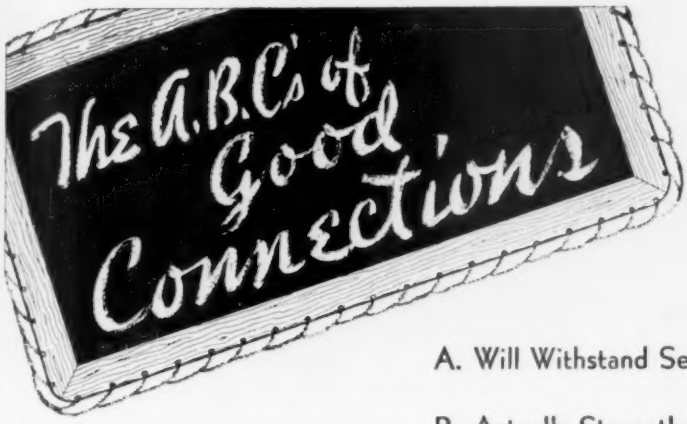

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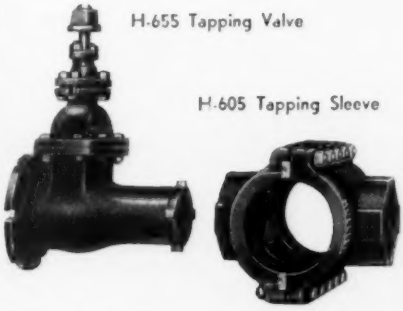

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(*Continued from page 16*)

A. E. Griffin of Wallace & Tiernan Co., Inc., covered four aspects of chlorination: super-chlorination, break-point-chlorination, marginal-chlorination and chlorine-ammonia treatment.

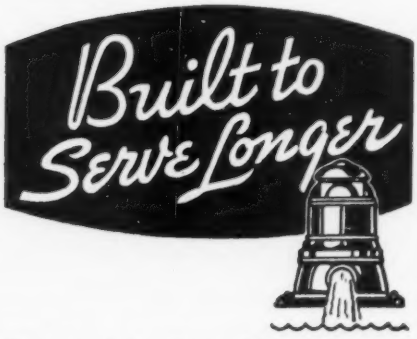
A highlight of the program was the paper by Roberts Hulbert and Douglas Feben—"Studies on the Accuracy of Threshold Odor Values." (For this paper, complete with discussions, see p. 1945, November 1941 JOURNAL.) The Michigan Section chose Messrs. Hulbert and Feben to receive the Fuller Award for their original and painstaking studies on the accuracy of odor determinations as evidenced by the paper.

The committee which organized the inspection trip to the Lake Michigan pumping station deserves commendation for the attendance of more than a hundred and for arranging the luncheon served there.

H. H. Caswell was elected Chairman, Leo E. McQueen becoming Past-Chairman. Louis B. Harrison was elected Vice-Chairman and Earl L. Halloway and R. Lee Sensabaugh were elected Trustees. L. G. Lenhardt continues in his term as A. W. W. A. Director and Maurice N. Gerardy continues as Secy-Treas.

MAURICE N. GERARDY
Secretary-Treasurer

(*Continued on page 20*)



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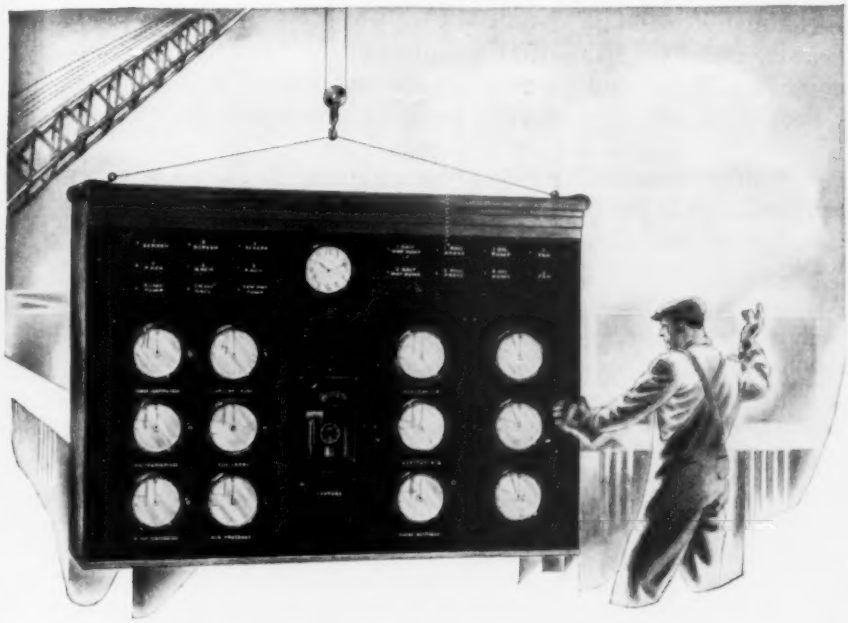

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(*Continued from page 18*)

Milton Roy Pumps are described in a well-illustrated, 16-page catalog recently issued by Milton Roy Pumps, 1328 E. Mermaid Ave., Philadelphia, Pa. Water works pumps in general as well as pumps for handling chemicals in precisely-controlled quantities are featured.

Printed copies of Simplified Practice Recommendation R181-41 Nonferrous Range Boilers, are now available, at 5 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

This recommendation was proposed by the Non-Ferrous Hot Water Tank Manufacturers Association with a view to conserving nonferrous metals by reducing unnecessary inventories of boilers. It covers a simplified list of 6 stock sizes ranging from 30 to 100 gal. capacity, and includes manufacturers' test procedure adopted by the Association for the guidance of those wishing to prepare specifications or codes. Each of the 6 sizes may be made in 3 working pressures and 2 styles, making a total of 36 varieties, which it is believed will satisfactorily meet a large percentage of normal requirements. The sponsors estimate that not less than 200 varieties of nonferrous range boilers were formerly being produced.

(*Continued on page 22*)

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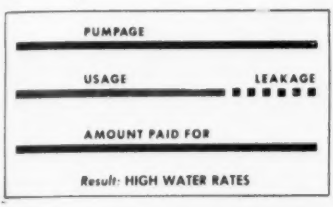

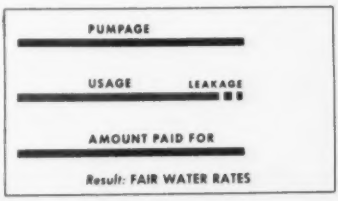

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(Continued from page 20)

Report of the Minnesota Section Meeting

The 25th Annual Meeting of the Minnesota Section was held at the Nicollet Hotel, Minneapolis, October 9–11. On this occasion of its silver anniversary, the Section awarded its Past Chairmen pins which were presented by Harry E. Jordan, Secy., A. W. W. A. The Section has had twenty three chairmen, and of the fourteen still living, thirteen attended the meeting.

H. A. Whittaker, a charter member of the Section, outlined the Section's history, while Messrs. Lewis I. Birdsall and Arthur F. Mellen, also charter members, gave short talks. After the minutes of the 1940 meeting were read and approved, the Chairman appointed the following committees, with the request that they report at the Friday business luncheon,—Nominating, Resolutions, and Auditing.

In the afternoon, Harry Stock, Engr. in Charge of Plants, Water Dept., Milwaukee, gave an excellent paper on "Materials Used in Water Distribution Systems." Discussions by Edgar W. Johnson, Sen. Engr., Minneapolis Water Dept., W. P. Tarbell, City Engr., Fargo, N. D., and

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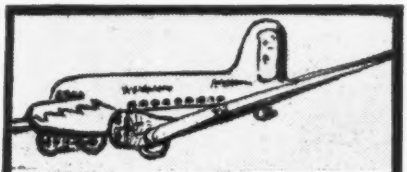

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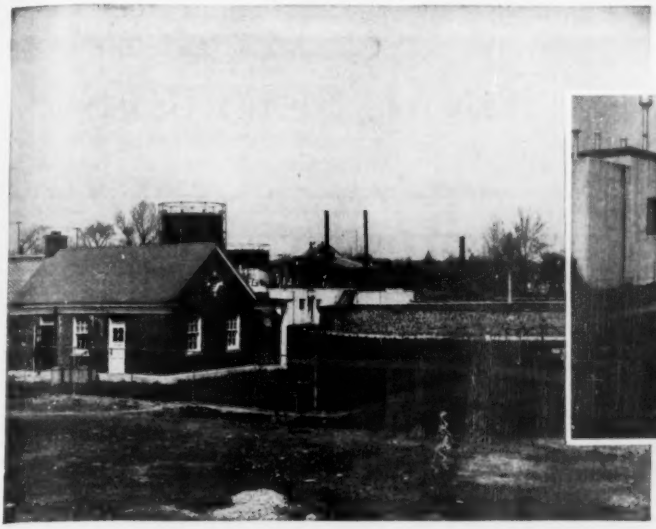

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(*Continued from page 22*)

W. D. Hurst, Asst. City Engr. and Engr. of Water Works, Winnipeg, brought out clearly that a vast variety of materials may be used satisfactorily in this region for mains and services.

J. Arthur Jensen, Engr., Water Works Dept., Minneapolis, gave an illustrated description of the insertion of valves in mains without shutting off the pressure. Both the machine for the installation and the valves were furnished by the A. P. Smith Mfg. Co. A. E. Griffin, Wallace & Tiernan Co., Inc., spoke on "Phenomenalistic Chlorination," discussions being given by J. J. Handy, San. Engr., Minneapolis, Earl H. Ruble, Water Dept., Duluth, and Herbert S. Grove, Engr. and Supt., Stillwater. Orville C. Peterson, Attorney for the League of Minnesota Municipalities, presented a paper on "Liabilities of Municipalities," which will appear soon in the JOURNAL. Also scheduled for early publication in the JOURNAL is "Practical Distribution System Design by the Hardy Cross Method" by W. D. Hurst, Engr. of Water Works, and N. S. Bubbis, Designing Draftsman, Winnipeg.

Frank Raab, Sen. Chemist and Bacteriologist, Fridley Softening Plant, Minneapolis, described the operations there, with ensuing discussions by Ross A. Thuma, Supt. of the Filter Plant, St. Paul, Joseph E. Young, Supt., Water Dept., Fergus Falls, and Wm. Yegen, Supt. of Filtration, Bismarck, N. D. Prevention of scale formation by phosphate treatment was covered by John D. Turner, Filter Plant Supt., Grand Forks, N. D., with discussions by M. H. Bischoff, The Flox Co., Minneapolis, and Bernard Grodin, Chem. Engr., Fuel Economy Engineering Co., St. Paul, Minn.

"Water Works Accounting" was the subject treated by W. H. Sherman, Supervisor, Municipal Accounting, State of Minnesota Dept. of the Public Examiner, St. Paul. Discussions were by J. M. Pinkerton, Principal Clerk, Water Dept., Minneapolis, and by John C. Flanagan, Asst. Secy. and Registrar, St. Paul Water Dept., who later gave a report on study of the "Accounting Manual."

At the business luncheon, Ross A. Thuma gave a report as A. W. W. A. Director; then O. E. Brownell, Director of the State Board of Health, reported for the Membership Committee. At this time Mr. Brownell opened discussion on the possibility of the Minnesota Water Works Conference being made a part of the Minnesota Section. It was Mr. Brownell's thought that the Section could have its regular, formal meeting once each year and also have two or three informal meetings such as the Conference has had in the past. Howard Sowden spoke in favor of the merger. Arthur F. Mellen moved that the Chairman appoint a Committee to investigate the matter and Frank Raab's amendment permitting action by a mail ballot to all the section was carried.

Licensing of operators was discussed by Ross A. Thuma who called

(*Continued on page 28*)

WORTHINGTON

EQUIPMENT FOR WATER SUPPLY

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IC1-21

(*Continued from page 26*)

for adoption of the report which had previously been mailed to all members. Joseph E. Young thought the report should be given further study and questioned whether public welfare demanded licensing of operators. Frank Raab supported the report but thought some modifications might be made. O. E. Brownell stated that the State has a civil service organization already established which is financially able to bear the burden of examining and licensing. Upon Mr. Mellen's motion, the Committee was instructed to investigate further possibilities.

H. S. Grove, Chairman of the Nominating Committee, asked for and received approval of the Executive Committee's action in appointing Ross A. Thuma to fill the unexpired term of A. W. W. A. Director Felix Seligman. Edgar W. Johnson was elected to serve as A. W. W. A. Director for the 1942–5 term; W. P. Tarbell was made Chairman; U. J. Seibert was elected Vice-Chairman; and Joseph E. Young was elected for a three-year term as Trustee. Other officers were continued in office.

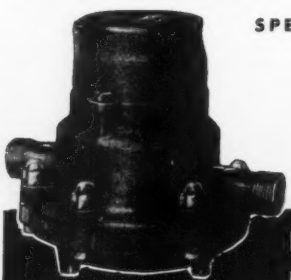
O. E. Brownell gave a history of the public water supplies in Minnesota, illustrating the talk with slides. "Proposed Standards for Purification Plant Operation," submitted for discussion at the Toronto Convention, were referred to a Committee for review with a request for a report at the next annual meeting.

Arthur F. Mellen, Supt. of Filtration, Columbia Heights Plant, Minneapolis, gave details on "Filters, Filter Materials and Underdrains." In discussion, L. N. Thompson reviewed some of the history and background of modern filtration methods, and Wm. Yegen cited his experience with various layers and his decision to build future filters with four sizes of gravel, with 6 in. of fine gravel in the top layer.

At the annual banquet Chairman Tarbell presented A. C. Janzig with the Past-Chairman's pin, and L. N. Thompson, Chairman of the Fuller Memorial Award Committee, announced the making of the award to Ronald M. Finch. There were 174 attending the banquet. Registrations for the meeting were 157, 108 having attended the luncheon.

(*Continued on page 30*)

FIRST QUALITY METERS EXCLUSIVELY



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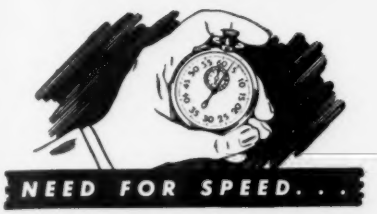

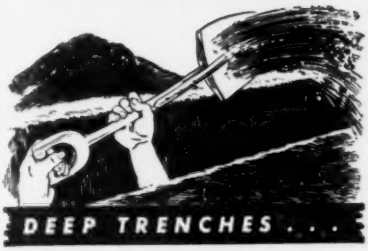

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(*Continued from page 28*)

Special entertainment for the ladies included a luncheon on Thursday at the Minneapolis Athletic Club, given by Wallace & Tiernan Co., Inc., with a card party at the Hotel following. On Friday noon there were a luncheon and style show at Dayton's Department Store, followed by drives about the city.

R. M. FINCH
Secretary-Treasurer

Those interested in the polarized dropping mercury electrode method of chemical analysis may obtain a 68-page bibliography of the subject by requesting Bibliography E-94(1) from Leeds and Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.

Northville, N. Y., has just completed improvements increasing the adequacy and safety of its water supply. A new reservoir holding 8 mil. gal. was constructed and the old reservoir's capacity was increased to 4 mil.gal. An aerator and diverting dam were constructed between the two reservoirs making it possible to draw water from either or both. A chlorination plant was put in service on October 14. It consists of a Wallace & Tiernan hypochlorinator and a Sparling meter. The consulting engineer was Morrell Vrooman of Gloversville, N. Y.

Report of the California Section Meeting

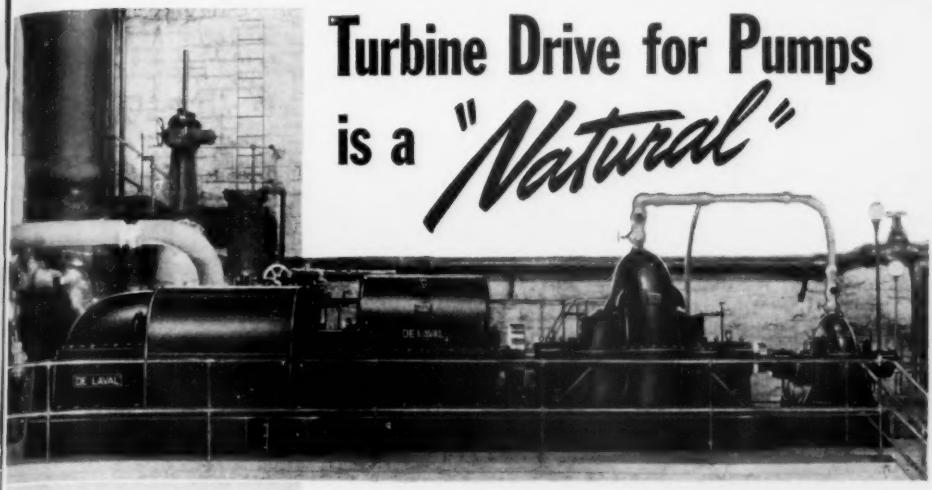
The 22nd Annual Meeting of the California Section was held at Fresno, October 22–24. The meeting opened Wednesday morning with a golf tournament at the Sunnyside Country Club. That afternoon there was an excursion to Friant Dam, one of the major units of the Central Valley Project. Buses took the delegates who were given a description of the project by one of the engineers of the Bureau of Reclamation.

The Annual Purification Dinner was held on Wednesday evening with Harry E. Jordan, Secy., A. W. W. A., giving an address on the defense activities of the Association. Entertaining musical numbers and a magic show closed the meeting.

Mayor Z. S. Leymel welcomed the delegates on Thursday morning, then Claude H. Weeks, Supt. of the Fresno Water Dept., described the system. S. O. Harper, Ch. Engr., Bureau of Reclamation, Denver, gave an interesting, illustrated talk on the Central Valley Project. Morris S. Jones, Ch. Engr. and Gen. Mgr., Pasadena Water Dept., presented a paper on "Financing Extensions of Water Mains," and water works accounting was covered by R. M. Sedgwick, Accountant, East Bay Municipal Utility Dist., Oakland. Other papers of this session were: "Eliminating Pumping Station Noises from Distribution Mains" by S. M. Dunn, Ch.

(*Continued on page 32*)

Turbine Drive for Pumps is a "Natural"



Geared pressure-stage turbine driving water works pump; 80 m.g.d. against 187 ft. head, using steam at 175 psi. and 533°F. This unit developed a duty of 222.8 million foot pounds per 1,000 lb. of steam, as corrected to contract conditions.

THE speed of steam turbine driven pumps can readily be controlled, either automatically or manually, to supply just the desired head and flow, thereby avoiding the great waste of power incurred in throttling motor-driven pumps to meet head and flow requirements.

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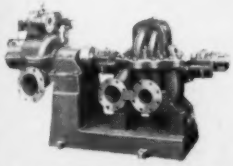
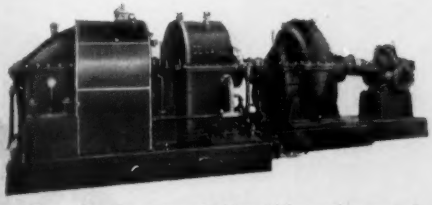
De Laval velocity-staged turbines exhausting to feed heaters or to process show similarly high economies and are most sturdy and reliable drives for power plant or process pumps.

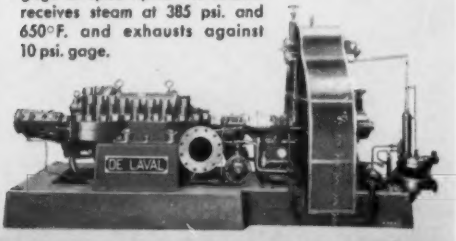
State your conditions and ask for Publication T-3525.



Velocity-stage turbine driving boiler-feed pump; 1,000 g.p.m. against 807 ft. head at 3,500 r.p.m.

Velocity-stage turbine driving six-stage boiler feeder; 850 g.p.m. of 220°F. water against 1,600 psi. gage at 3,550 r.p.m. The turbine receives steam at 385 psi. and 650°F. and exhausts against 10 psi. gage.





Geared pressure-stage turbine driving main pump of 20,000 g.p.m. capacity against 148 ft. head and condenser circulating pump of 1,300 g.p.m. against 60 ft. head.

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(*Continued from page 30*)

Mech. Engr., Los Angeles Water Dept., and "Removal and Repair of Water Meters" by G. W. Pracy, Supt. of the San Francisco Water Dept.

At the parallel session on purification, under the Chairmanship of C. W. Sopp of Pasadena, the program included "Transportation of Sediment Through Reservoirs" by R. T. Knapp of the California Institute of Technology; "Sanitary Construction and Protection of Wells" by H. J. Ongerth, San. Engr., State Dept. of Health, Berkeley; and "Limnological Observations on San Francisco Reservoirs" by H. C. Medberry, Water Purif. Engr., San Francisco Water Dept.

In the Friday morning sessions there were the following papers: "Water Quality Problems in the Operation of Small Systems" by L. C. Cook, Mgr., Willow Road Water Dist., Menlo Park; "National Defense and Water Supplies" by Earl Warren, Attorney General of California; "Wartime Precautions in Water Supply Protection" by R. F. Goudey, San. Engr., Los Angeles Water Dept.; and "Review of the Manual on Water Quality and Treatment and Manual on Treatment Plant Design" by Chas. G. Hyde, Prof. San. Eng., Univ. of California, Berkeley. In the afternoon two round table sessions were conducted, a general session

(*Continued on page 34*)

Newly Available Reprints

Tentative Standard Specifications for Sluice Gates—7F.2 T. Approved as Tentative Specifications by the A.W.W.A. June 26, 1941 and published as a part of the October 1941 Journal. 11 pp. Reprints, 15¢ per copy.

Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs—7H.1–1941. Published as a Tentative Standard as a part of the December 1940 Journal and adopted as a full Standard by the A.W.W.A. June 26, 1941 and by the American Welding Society July 23, 1941. Reprints in two sizes—8½ in. by 11 in. for binding with contract documents, and 6 in. by 9 in. for reference—30¢ per copy.

American Water Works Association

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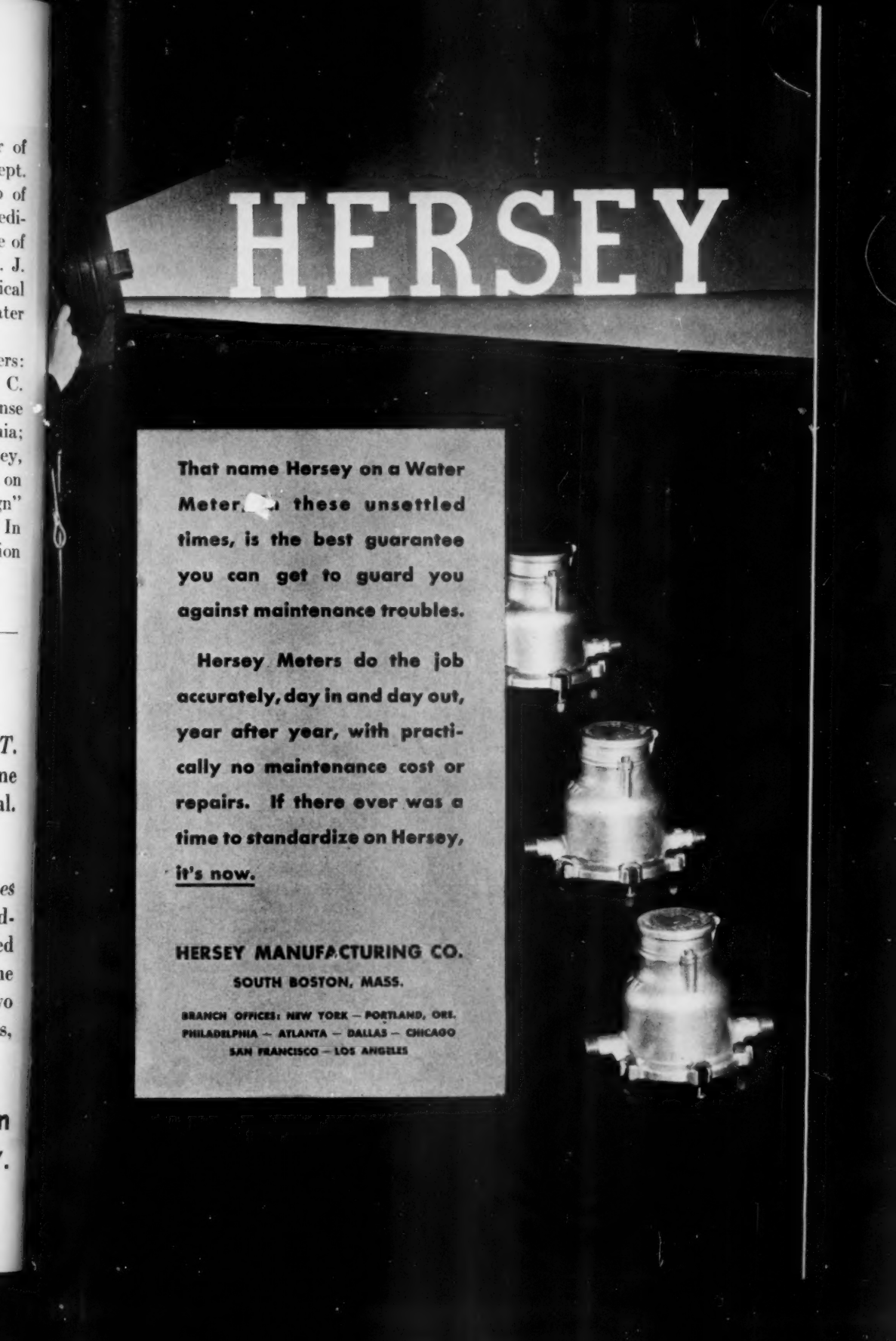
HERSEY
That name Hersey on a Water Meter in these unsettled times, is the best guarantee you can get to guard you against maintenance troubles.
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(*Continued from page 32*)

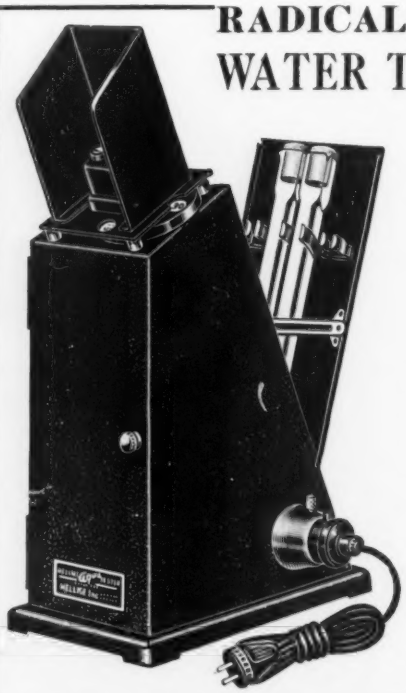
by Samuel B. Morris and a purification session by C. W. Sopp. J. S. Longwell, Chairman of the Section, presided over the technical sessions.

At the business session following the dinner on Thursday evening, A. W. W. A. President Louis R. Howson addressed the assembly. The section officers elected for the coming year are: Chairman, Morris S. Jones of Pasadena; Vice-Chairman, J. S. Peters of San Rafael; Secretary-Treasurer, G. E. Arnold of San Francisco; Executive Committee, J. R. Baker of San Francisco, C. P. Harnish of Los Angeles, Jeptha A. Wade of San Jose and Robert C. Kennedy of Oakland. The new A. W. W. A. Director is John S. Longwell of Oakland.

The annual dinner dance was held on Friday evening in the Rainbow Ballroom of the Hotel Fresno where an excellent dinner was enjoyed and very pleasant entertainment was provided by the Water and Sewage Works Mfrs. Assn., of which the following national officers were present: Karl Mann, Edgar J. Buttenheim and Arthur Clark.

Ladies entertainment included: the excursion to Friant Dam; a tour of the Roma Winery and the Sun Maid Raisin Plant, at Fresno, the largest plants of their kind in the world; a tour and bridge party at the Elks Club and a luncheon at Pine Lake Lodge in the suburbs of Fresno.

(*Continued on page 36*)



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(*Continued from page 34*)

The registration was not quite as large as in some previous years, being a little under 700. This decrease was attributed to defense activities and to the holding of the meeting elsewhere than in one of the large population centers of the state. There were, however, members and guests present from most of the eleven western states.

Charles Gilman Hyde, Prof. San. Eng. at the University of California, was chosen for the Fuller Memorial Award.

The Membership Committee reported a total of 547 California Section Members—the largest number of any section of the A. W. W. A.—and the Old Oaken Bucket, awarded to the largest A. W. W. A. section, was on display during the meeting.

The convention, although not the largest ever held by the section, was one of the best, and Chairman Longwell and his committee members are to be congratulated on the excellent arrangements.

GERALD E. ARNOLD
Secretary-Treasurer

Report of the Missouri Valley Section Meeting

The 26th Annual Meeting of the Missouri Valley was held at the Hotel Montrose in Cedar Rapids, Mo., October 20–22, with a total registration of 153.

Officers elected for the coming year were: William T. Bailey of Council Bluffs, Iowa, Chairman; Rhea Rees of Sioux Falls, S. D., Vice-Chairman; Earle L. Waterman of Iowa City, Iowa, Secretary-Treasurer; and for Directors, W. S. Watson of Hannibal, Mo., Frank E. Wiley of Lawrence, Kan., J. Rex Henry of Fremont, Neb., Everett R. Mathews of Pierre, S. D., and J. J. Hail of Dubuque, Iowa.

William T. Bailey was nominated for the Fuller Award in recognition of his outstanding work in the operation of the Council Bluffs treatment plant, his contributions to the advancement of knowledge in the field of water purification, and his participation in community affairs.

Resolutions were adopted calling attention of the OPM to the importance of public water supplies in the national defense program and urging that serious consideration be given to a more liberal allocation of essential chemicals and materials necessary to preserve the standards required to maintain public health in both defense and non-defense areas. The opening session of the meeting was given over to a round table discussion of "Water Works and the National Defense Program." There are a number of national defense projects in the Missouri Valley Section area and it was brought out that the locating of these projects near certain cities had brought problems to the water works management. In some instances, as at Burlington near which a shell loading plant has been built, the increase in population has resulted in higher water consumption.

(*Continued on page 38*)

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A large stock constantly on hand,
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EVERETT, MASS.

(Continued from page 36)

Reports indicated, however, that for the most part the increased demand was being taken care of by existing facilities.

The Des Moines water works is to supply an average of 2.5 m.g.d. (maximum, 3.6 m.g.d.) to the small arms ammunition plant located at Ankeny just north of the city. A recently completed 10-mil. gal. storage reservoir will help in carrying this additional load which is about a 20 per cent addition to the normal load. The construction of a stream regulation storage reservoir on the upper reaches of the Racoon River, which has been recently started, will be hastened to provide an increased supply at the source.

Superintendents of plants not directly involved in the water supply problems connected with defense projects reported some difficulties in the matter of priorities. Present extension work is being done with materials on hand. Supplies of chemicals for water treatment plants are being obtained, but concern was expressed about possible limitation of quantities to those used in previous years. It was maintained that the wide variation in the quality of many raw waters in this area makes it almost impossible to establish on a yearly basis the amounts of chemicals required for adequate purification.

(Continued on page 40)

CLEAN YOUR WATER MAINS

One does not have to be an expert mathematician to figure out that a clogged water main calls for a stronger pressure and that in turn calls for more coal—and literally burning up money. We can show you how to get dollar for dollar value out of every ton of coal. We can show you how to clean the water mains quickly and cheaply. Send us your address—that's all we ask of you.

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406 Florida Theatre Bldg., Jacksonville, Fla.
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501 Howard St., San Francisco, Calif.
2028 Union Ave., Montreal, Canada

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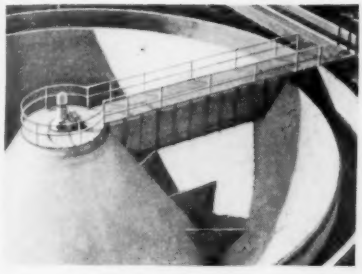

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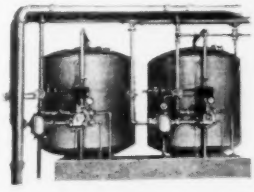

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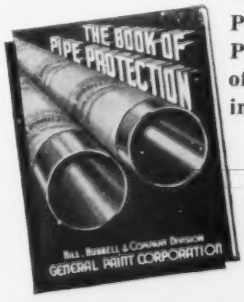

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(*Continued from page 38*)

Considerable interest was expressed in the likely supply of chlorine for water treatment and sanitation. At present there is little difficulty in securing allotments of the chemical itself—but there is an acute problem in finding containers in which to ship it. Water works men were prevailed upon not only not to hoard containers but also to exercise special care to insure the prompt return of empty containers.

It was suggested that each superintendent make a list of material and equipment on hand but for which he has no immediate need. These lists are to be available to members of the Missouri Valley Section so that such material may be located when a serious need arises.

Louis R. Howson, President of the A. W. W. A., Edward Bartow and J. Arthur Jensen, Past Presidents of the Association were honored guests at the meeting. Mr. Howson outlined the current activities of the A. W. W. A., particularly with reference to national defense matters. This was followed by a very interesting talk on "Present Trends in Water Works Practice." Mr. Howson pointed out some of the progress which has been made in filter design, pumps, meters and water softening.

M. E. Rogers, Production Supt., Wichita, Kan., Municipal Water Supply Plant, described the problems encountered during the first year's operation of the new Wichita plant. A paper by H. S. Morgan of the Cedar Rapids Water Dept. on "Personnel Relations" emphasized the importance of providing good working conditions for employees.

Rhea Rees of Sioux Falls in his paper "Your Water Department and its Relation to City Finances" started a spirited discussion on the important question of the diversion of water department funds. As usual when this topic is discussed there was no definite decision. The paper on "Water Treatment Problems in South Dakota" by Everett R. Mathews described some interesting research that is being carried on at Sioux Falls to determine more effective treatment processes for iron and manganese removal. In the discussion it was brought out that the operation of the Fort Peck Dam has resulted in appreciable changes in the turbidities, tastes and odors of the Missouri River water.

Col. F. S. Besson, representing the Army Engineers, described the "Missouri River Improvements and Their Relation to Valley Properties." He pointed out that in some instances these improvements had greatly improved water works intakes by stabilizing the river channel. In discussing the paper, W. T. Bailey and A. H. Wieters described the plight of the Council Bluffs Water Works which, because of the change in the location of the river channel, must build about 7,000 ft. of new supply line and a new intake. Under present law this is consequential damage for which there appears to be no recourse other than new legislation.

"A New Water Softening Plant at Harper, Iowa" was described by D. C. Senges. This plant treats a well water that is used for cooling water

(*Continued on page 42*)

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(*Continued from page 40*)

at a gas pumping plant. The process uses both lime softening and zeolite processes. Roger Higgins of Chillicothe, Mo., described experiences with the "Use of Ferrisul as a Coagulant." While excellent results have been obtained at the Chillicothe plant, it was pointed out that this material was becoming difficult to obtain because certain ingredients used in its manufacture are used in making paint which is given priority. At St. Louis, laboratory experiments have not shown that Ferrisul gives any better results than the iron lime process.

"Kansas City's Water Softening Improvements" were described by Melvin P. Hatcher. The work there is now under construction and includes some interesting design features to fit the improvements into existing structures.

Vance C. Lischer in a paper on "The Maintenance of Water Works Pumps" described the machine shop which has been developed at the St. Louis County Water Co. plant, and its use in the maintenance of equipment. In the discussion of this paper, it was brought out that a plant having a capacity of 10 m.g.d. or more could well afford to provide such maintenance equipment.

EARLE L. WATERMAN
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(*Continued from page viii*)

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(*Continued on page 44*)

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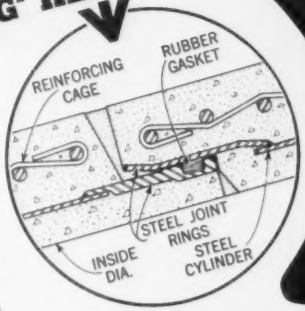

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April 15-17—Canadian Section in Niagara Falls, Ont., Canada. Secretary, Dr. A. E. Berry, Director, Ontario Dept. of Health, Parliament Bldg., Toronto, Ont., Canada.

April 20-22—Southeastern Section in Savannah, Ga. Secretary, B. P. Rice, Supervising Engr., Reconstruction Finance Corp., Bond Service Division, Atlanta, Ga.

May 7-9—Pacific Northwest Section at Marcus Whitman Hotel, in Walla Walla, Wash. Secretary, Fred Merryfield, Asso. Prof. of Civil Engineering, Oregon State College, Corvallis, Ore.

May 15-16—Ohio Section in Toledo, Ohio. Secretary, Thomas R. Lathrop, San. Engr., 2328 Arlington Ave., Columbus, Ohio.

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(Continued on page 42)

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(*Continued from page 42*)

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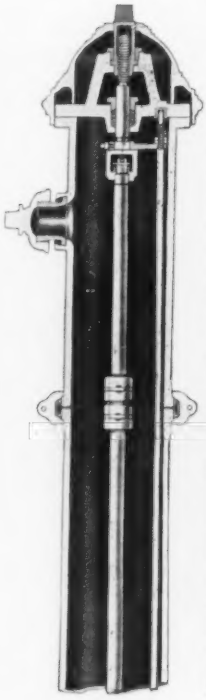

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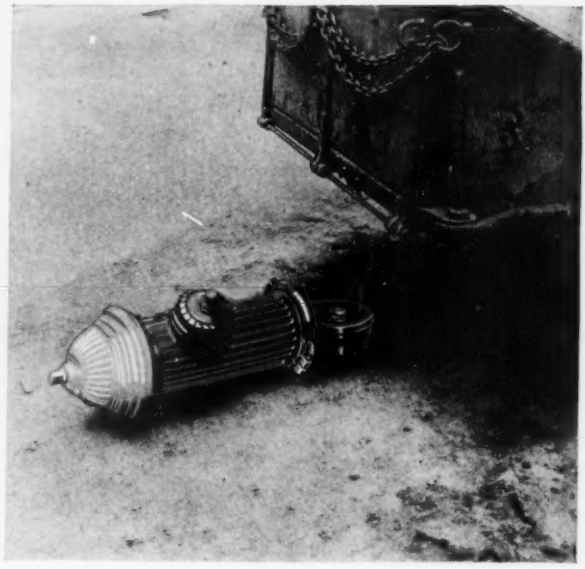

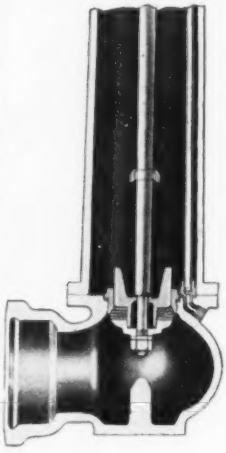

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ALPHABETICAL LIST OF ADVERTISERS

	PAGE
Activated Alum Corp. (Stuart-Brumley Corp.)	45
Albright & Friel, Inc.	24
Alco Products Div. of American Locomotive Co	15
Alvord, Burdick & Howson	24
American Brass Co., The	10
American Cast Iron Pipe Co.	—
American Rolling Mill Co., The	—
American Water Softener Co	—
Atlas Mineral Products Co., The	18
Barrett Co., The	—
Black & Veatch	24
Buck, Seifert and Jost	24
Buffalo Meter Co.	28
Builders-Providence, Inc. (Division of Builders Iron Foundry)	41
Burns & McDonnell Engineering Co	24
Caird, James M.	24
Calgon, Inc.	7
Cast Iron Pipe Research Assn., The	3
Central Foundry Co., The	8
Centriline Corp	—
Chemlab Specialties Co	—
Chester Engineers, The	24
Chicago Bridge & Iron Co	—
Cliffs Dow Chemical Co	vii
Consoer, Townsend & Quinlan	24
Cook, A. D., Inc	44
Craig, Robert Hall	24
Crane Co	35
Darco Corp	—
Dawes Silica Mining Co	6
DeLaval Steam Turbine Co	31
Difco Laboratories	—
Dorr Co., The	5
Dresser Mfg. Co.	Cover 3
Edson Corp., The	12
Electro Rust-Proofing Co	10
Federation of Sewage Works Association	41
Ford Meter Box Co., The	8
Foxboro Co., The	19
General Chemical Co	—
General Paint Corp	39
Greeley & Hansen	24
Grinnell Co.	—
Havens & Emerson	25
Hays Mfg. Co.	—
Hellige, Inc.	34
Hersey Mfg. Co.	33
Hill, Hubbell & Co. Div.	39
Hydraulic Development Corp.	20
Industrial Chemical Sales Division, West Virginia Pulp & Paper Co	x
International Filter Co.	—
Johns-Manville Corp.	ix
Keasbey & Mattison Co.	29
Kennedy Valve Mfg. Co., The	13
Knowles, Morris, Inc	25
Kupferle, John C., Foundry Co.	22
LaMotte Chemical Products Co.	6
Layne & Bowler, Inc.	18
Leadite Co., The	Cover 4
Lock Joint Pipe Co	i
Ludlow Valve Mfg. Co., The	14
M & H Valve & Fittings Co	6
Mabbs Hydraulic Packing Co.	44
Mathieson Alkali Works, Inc., The	23
Metcalf & Eddy	25
Mueller Company	17
National Meter Div	—
National Water Main Cleaning Co	38
Neptune Meter Co	21
Newsom & Aldrich	25
Northern Gravel Co	14
Ozone Processes, Inc.	—
Peerless Pump Div	22
Pennsylvania Salt Mfg. Co	—
Permutit Company, The	39
Phelps Dodge Refining Corp	—
Pirnie, Malcolm	25
Pitometer Co	25
Pittsburgh-Des Moines Steel Co.	9
Pittsburgh Equitable Meter Co.	54
Quigley Co., Inc.	—
Refinite Corporation	—
Regester, Robert T.	25
Reilly Tar & Chemical Co.	—
Rensselaer Valve Co	11
Ross Valve Mfg. Co	—
Rusta Restor Corp	14
Scofield Engineering Co	25
Skinner, M. B., Co.	—
Smith, A. P., Mfg. Co., The	46
Smith, S. Morgan, Co.	v
Solvay Sales Corp	—
Stuart-Brumley Corp.	45
Syntron Company	—
U. S. Pipe & Foundry Co	iii
Wailes Dove-Hermiston Corp.	43
Wallace & Tiernan Co., Inc.	xii
Warren Foundry & Pipe Co.	37
Weston & Sampson	25
Whitman, Requardt & Smith	25
Wood, R. D., Co.	Cover 2
Worthington-Gamon Meter Co.	—
Worthington Pump & Mach. Corp.	27
Zeolite Chemical Co.	16

CLASSIFIED INDEX TO ADVERTISEMENTS

Access Shafting:
Alco Products Div., Am. Loco. Co.

Activated Carbon:
Activated Alum Corp.
Cliffs Dow Chemical Co.
Darco Corporation
Industrial Chemical Sales
International Filter Co.

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Worthington Pump & Mach. Corp.

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Industrial Chemical Sales
Mathieson Alkali Works (Inc.)
Phelps Dodge Refining Corp.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.

Chemists and Engineers:
(See Directory of Experts, page 24)

Chlorinators:
Wallace & Tiernan Co., Inc.

Chlorine Comparator:
Hellige, Inc.
Wallace & Tiernan Co., Inc.

Chlorine, Liquid:
Mathieson Alkali Works (Inc.)
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Engines, Gas:
Worthington Pump & Mach. Corp.
Engines, Hydraulic:
Ross Valve Mfg. Co.
Engineers and Chemists.
Cliffs Dow Chemical Co.
(See Directory of Experts, page 24)
Feed Water Filters:
International Filter Co.
Ross Valve Mfg. Co.
Feed Water Heaters:
Worthington Pump & Mach. Corp.
Feed Water Testing Outfits:
Hellige, Inc.
Feed Water Treatment:
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(See Jointing Materials)
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DeLaval Steam Turbine Co.
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Worthington Pump & Mach. Corp.
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Ozone Processes, Inc.
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Ford Meter Box Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.
Valve Inserting Machines:
A. P. Smith Mfg. Co.
Valves, Altitude:
Ross Valve Mfg. Co., Inc.
S. Morgan Smith Co.
Valves, Check, Flap, Foot, Hose, Mud and Plug:
A. D. Cook, Inc.
Crane Co.
Ludlow Valve Mfg. Co.
Valves, Check, Flap, Foot, Hose, Mud and Plug:
Mueller Co.
Rensselaer Valve Co.
S. Morgan Smith Co.
R. D. Wood Co.

Valves, Detector Check:
Hersey Mfg. Co.
Grinnell Co.

Valves, Float:
Crane Co.
Ludlow Valve Mfg. Co.
Ross Valve Mfg. Co., Inc.
S. Morgan Smith Co.

Valves, Gate:
Crane Co.
Dresser Mfg. Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
M & H Valve & Fittings Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Large Diameter:
Alco Products Div., Am. Loco. Co.
Crane Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
S. Morgan Smith Co.
R. D. Wood Co.

Valves, Regulating:
Crane Co.
Mueller Co.
Ross Valve Mfg. Co.
S. Morgan Smith Co.

Valves, Relief (Temperature and Pressure):
Crane Co.
Mueller Co.
S. Morgan Smith Co.

Valves, Swing Check:
Crane Co.
Grinnell Co.
Kennedy Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Mueller Co.
Rensselaer Valve Co.
A. P. Smith Mfg. Co.
R. D. Wood Co.

Valves, Uniflow Check (for Double Check Service):
Grinnell Co.

Valves, Water Meter Protection:
Crane Co.

Water Softener (Hot Lime Soda):
International Filter Co.

Water Softener (Zeolite):
International Filter Co.
Refinite Corporation
Zeolite Chemical Co.

Water Softening Plants:
American Water Softener Co.
Chicago Bridge and Iron Company
Dorr Co.
International Filter Co.
Permutit Company
Pittsburgh-Des Moines Steel Co.

Water Sterilization:
Calgon, Inc.
Ozone Processes, Inc.

Water Supply Contractors:
A. D. Cook, Inc.

Water Testing Apparatus:
Chemlab Specialties Co.
Hellige, Inc.
Wallace & Tiernan Co., Inc.

Water Treatment Plants:
Chicago Bridge & Iron Company
Dorr Co.
International Filter Co.
Ozone Processes, Inc.
Pittsburgh-Des Moines Steel Co.
Refinite Corporation
Wallace & Tiernan Co., Inc.

Water Waste Detection:
Pitometer Co.

Water Works Construction, General:
Pittsburgh-Des Moines Steel Co.

Well Drilling Contractors:
A. D. Cook, Inc.
Layne & Bowler, Inc.

Well Screens:
A. D. Cook, Inc.
Crane Co.

Wrenches, Ratchet:
Crane Co.
Dresser Mfg. Co.

Zeolite Water Softeners:
International Filter Co.
Permutit Co.

WHO PAYS FOR THE WATER THAT *Leaky* FIXTURES WASTE

LEAKY fixtures on the consumer's property have long been a trial to waterworks men. The big leaks, such as faulty toilet valves, are easily registered by any water meter in fair condition. These leaks the consumer quickly corrects when the first water bill arrives.

But the little leaks, those of ¼ g.p.m. or less, usually go unnoticed, since the average domestic meter will not measure them with any satisfactory degree of accuracy. Little drops of water accumulating over a period of time will amount to a surprisingly large volume. Who pays for this waste?—the water plant, of course, in the form of increased pumping, filtration and treatment costs.

Small leaks of water become big leaks in revenue. Pittsburgh IMO Meters, through their ability to consistently measure these trickles of water, are materially increasing revenues in thousands of waterworks systems the country over. These meters can be trusted to produce the maximum return from any and all services, even after millions of gallons have been measured. They always operate quietly, last longer and require fewer repairs. They cost less because they measure more.

PITTSBURGH IMO METER

PITTSBURGH EQUITABLE METER COMPANY

NEW YORK · BROOKLYN · DES MOINES · MEMPHIS · DALLAS · TULSA · CHICAGO · BOSTON

MERCO NORDSTROM VALVE COMPANY
Main Offices, Pittsburgh, Pa.
NATIONAL METER DIVISION, Brooklyn, N. Y.

KANSAS CITY · PHILADELPHIA · SAN FRANCISCO · LOS ANGELES · SEATTLE · HOUSTON · COLUMBIA · BUFFALO

Pittsburgh-National Meters

THE MOST COMPLETE LINE OF WATER METERS IN THE WORLD

Time Is Short and There Are Only 24 Hours in a Day

The defense activities in Washington are affecting the water works field increasingly as every day passes. The American Water Works Association has recognized the importance of this problem and the Board of Directors, at its Toronto meeting, authorized the creation of a "Committee on Defense." The Committee consists of the following persons:

Louis R. Howson,—*President, A.W.W.A.*
Abel Wolman,—*Vice-President, A.W.W.A.*
Eugene F. Dugger—*General Manager, Newport News Water Dept.*
Boyd A. Bennett—*President, Northeastern Water & Electric Service Corp.*
John A. Kienle—*Secretary, Water and Sewage Works Manufacturers Assn.*
Harry E. Jordan—*Secretary, A.W.W.A.*

The scope of the Committee's activities may be defined as follows:

1. To obtain accurate data concerning the materials and supply situation within the water supply field.
2. To present the situation to the proper authorities in Washington and obtain such rulings as may be possible.
3. To transmit the information thus obtained to the water works management field.

The headquarters office staff of the American Water Works Association is charged with the responsibility of collecting any and all information relating to the needs of the water works field as they may be affected by the defense emergency activities.

In the interest of good management of water works and in the interest of ability of the Association's staff to serve its constituents, any water works man who finds himself unable to obtain necessary supplies, maintenance material, or material necessary for vital extension of water services should write or wire the Association's office *giving the facts*. The facts related should record the material needed and/or ordered, the amount, the name of the firm with whom the order was placed and the reasons given why the order

cannot be filled, or why its execution will be delayed. Do not waste time by reporting rumors concerning the possible future shortage of material for some other water works property. Tell only your own story. Let the other fellow tell his. Give only facts and especially require people with whom you are dealing in these emergency matters to record in writing what they have to say. The spoken word is very hard to use as a basis for representations on behalf of a water department that is in trouble.

On the pages immediately following is the story of chlorine priority. Chlorine for water treatment purposes has been placed on a basis equal to chlorine used in defense activities.

At the moment there is no priorities rating for any industry. There may be before this issue of the Journal reaches its readers. There are blanket ratings for such materials as machine tools and freight cars. There are project ratings of the highest standing and it is reasonably possible that water plants faced with an increased demand because of defense industries in the communities served by them will be able to obtain project ratings that will give them rapid clearance for their needs. Such preference ratings when obtained may be applied to the subcontracts involved in keeping the operation going. The details of this procedure must be developed by experience.

The man is yet to be found in the Office of Production Management or in the Priorities Division who does not hold the opinion that public water supply service is an essential civilian operation and its maintenance the essence of a successful defense plan. The water supply operators in the United States have an opportunity to demonstrate their best qualities by cooperating fully in the efforts which the American Water Works Association is making on behalf of every water-using citizen in the Country.

Harry E. Jordan
Secretary

July 2, 1941

Essential Supplies for Water Works

The following exchange of correspondence is of vital importance to the entire water supply field and is reproduced without comment so that every reader of this JOURNAL *may have the information contained therein in his possession.*

HARRY E. JORDAN, Secretary

Federal Price Control Administrator Leon Henderson has announced that twenty-six specified industries and public services have been given priority on certain materials needed for repair and maintenance of their equipment. The order gives them first call on materials which compete with other civilian needs after defense requirements have been met. The industries are:

Water and gas production and distribution; sewer service; fire and police protective services; street railway, subway, elevated and interurban lines; commercial air lines maintaining regularly scheduled service; commercial bus lines; ocean, lake, river and canal shipping; oil and gas pipe lines; commercial operation of motor trucks; highway maintenance; telephone, telegraph and radio communications; railroads; electrical-energy production and distribution; petroleum production and refining; food processing and storing; mining and quarrying; coke converting; metallurgical plants; chemical production; industrial and academic research; hospitals, clinics and sanatoria, and public buildings, institutions, schools and parks.

From Surgeon General Thomas Parran to Secretary Harry E. Jordan—June 27, 1941

Concerning the matter of possible shortages of chlorine for sanitation purposes and particularly for disinfection of public water supplies, I am enclosing correspondence with Mr. E. R. Stettinius, Jr., Director of Priorities, Division of the Office of Production Management.

You are at liberty to use the information contained in this correspondence in order that the policy of the Office of Production Management concerning the preferential treatment that will be accorded the use of chlorine for sanitation purposes by that office may be generally known.

It is my intention to advise each State health officer of the attitude of the Office of Production Management concerning this matter. To facilitate handling of cases where excessive hoarding or a real shortage of chlorine has occurred, as suggested in Mr. Stettinius' letter, it is suggested that such situations could receive more prompt attention should they be made known to the State department of health having jurisdiction. Upon notification by the State health officer my office will undertake to report promptly such cases to the Office of Production Management in accordance with Mr. Stettinius' request.

From Dr. Parran to Director of Priorities Edward R. Stettinius — June 14, 1941

For several weeks past we have been concerned in the Public Health Service with the question of an assured adequate supply of chlorine necessary for such fundamental public health uses as in the sanitation of public water supplies, in sewage disposal, and in swimming pools.

In conference with representatives of the American Water Works Association, I have been informed that production facilities are apparently adequate to provide sufficient chlorine to meet civilian demands, but a problem is developing in respect to shipping containers. I am told that a shortage of these containers is developing by reason of excess orders placed by consumers who anticipated a future inability to maintain the stocks of material necessary for normal operations.

It is the opinion of the representatives of the American Water Works Association that the fear of future shortages in chlorine on the part of water works and sewage system operators is the basic reason for present practices of overstocking their supplies of chlorine. The view is expressed that this problem can be satisfactorily met if a statement could be obtained from you to the effect that assurance can be given that there will be no interruption to the flow of chlorine necessary to the satisfactory operation of these basic sanitary facilities.

I am informed that you have already stated at an editorial conference that you could foresee no possible demands upon the chlorine supply of the country which would interfere with its availability for public health and sanitation requirements. I should appreciate it if you would give me a statement to that effect, which I, in turn, could transmit through the several State Health Departments to the producers and consumers of chlorine in the operation of sanitation facilities.

From Mr. Stettinius to Dr. Parran—June 23, 1941

In reply to your letter of recent date regarding the chlorine situation, I am advised that you were correctly informed as to the adequacy of the supply of chlorine to meet the requirements of public health. In fact, I am assured that these needs, which account for only about five percent of the output of the whole industry, will receive preferential treatment on a basis of equality with direct defense application.

Moreover, similar treatment will be accorded with regard to containers, although in this respect it may be necessary to overcome hoarding if this becomes bothersome as indicated in your letter. Still, it is understood that the producers are aware of this situation and, knowing the normal requirements of their customers, should be in a position to control the accumulation of excessive stocks in improper places.

In case you have further questions or if you hear of cases where excessive hoarding or a real shortage has occurred, it will be appreciated if you would get in touch with this office at once.

From Brigadier General Charles Hines to Secretary Warren N. Watson of the Chemical Advisory Committee of the Army and Navy Munitions Board—June 12, 1941

Your Alkali and Chlorine Subcommittee's report on chlorine, dated May 27, 1941, indicates that direct and indirect military requirements for 190,000 tons of chlorine for the current year 1941, are approximately 30 percent of the present productive capacity of 725,000 tons. Such current capacity will be 75,000 tons less than military plus civilian demands for the remainder of the calendar year 1941.

Chlorine is on the Army and Navy Munitions Board Priorities Critical List and subject to preference ratings when used on defense orders. If each producer of chlorine would voluntarily accept defense orders, which are automatically subject to preference rating, up to at least 30 percent of his productive capacity, defense needs would be filled. It is also necessary that the chlorine industry supply the relatively small needs for sanitation, public water and sewage systems, food industries, and medicinals; which amount to only 5% of production. It appears that successful operation of such a voluntary plan may forestall mandatory priorities.

It is requested that the Committee periodically collect such statistics as may be necessary to study the relationship of defense orders and chlorine production. Data relative to new expansions are also desired.

From Assistant Director of Priorities Blackwell Smith to L. H. Enslow, Editor of Water Works and Sewerage—June 9, 1941

In response to your letter of June 2, you may quote me as saying that it will certainly be our policy to see to it that sudden needs for supplying water to essential industrial operations or housing developments in connection with expanding national defense will not fail for lack of priority if there is no alternative remedy reasonably available.

APPLICATION FOR MEMBERSHIP
IN THE
AMERICAN WATER WORKS ASSOCIATION

22 EAST 40th ST., NEW YORK

Date:.....

..... hereby make application for
(I or We)

.....
(Active, Junior, Corporate or Associate Membership, or Affiliate)

in the American Water Works Association, and enclose herewith the sum of $....., one year's dues in advance.

Name.....

Company or Department.....

Title or Position.....

Address.....

.....

If application is for Junior Membership, give date of birth.....

If application is for Affiliate, state number of active services in property where employed .....

Nature of business or character of work (for office records).....

.....

.....

.....

.....

.....

.....

.....

.....

.....

If application is for Corporate or Associate Membership, it must be signed by the person designated to represent the firm or corporation in A.W.W.A. activities.

.....
Signature of Applicant.

Application obtained by:

.....

(over)

ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, $10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

How to Obtain Water Works Materials

Those who are faced with the problem of obtaining structural materials, equipment or supplies at this time of heavy defense demand upon all raw materials should note the following:

The Office of Production Management controls the preference ratings upon materials which are important to the defense program and the available stock is so limited that one class of uses must be given preference over another.

Among the raw materials entering into water works construction and operation—pig iron, copper, zinc, rubber, nickel, aluminum and liquid chlorine are now under close control. There are others now and there will doubtless be additions from day to day.

The Office of Production Management has established (as of August 1, 1941) sixteen *Field Offices* where detailed information concerning procedure may be obtained. These offices are in Boston, New York, Philadelphia, Atlanta, Pittsburgh, Cleveland, Detroit, Cincinnati, Chicago, St. Louis, Kansas City, Dallas, Denver, Seattle, San Francisco and Los Angeles. Write to or call upon, for any information needed, the *District Manager, Office of Production Management* in the nearest city above listed which is in your Federal Reserve District. If there is no field office in your Federal Reserve District, write the nearest field office in a neighboring district.

If a water works manager or superintendent is called upon to *extend service* in any way because of a *defense* activity in his service area, there is little likelihood that he will be able to get delivery of what he needs without a preference rating. The forms to be used (PD-1) are reproduced in this issue of the JOURNAL—but *these reproductions are for information only*. Do not use them in making an application but get official copies from the O.P.M.

Keep these points in mind:

1—If you need to buy pipe, pumps, hydrants, valves, etc. to *extend your facilities* in any way and the need is caused by a *defense* project in your service area, apply for a preference rating on what you need to install.

2—Obtain the co-operation of the government contracting officer; get the designation and number of the contract or project in his charge and refer to it in answering questions 4 and 10 on form PD-1.

3—Further information by letter which will make clear just what *defense* activity you are trying to serve will help the O.P.M. staff and help you.

4—Remember: one set of application forms must be filled out for each *supplier* from whom you wish to obtain material.

5—Make yourself plain—do not assume that the person who handles your application knows a thing about any item on the application. *Put your facts on paper*—do not leave anything for anyone else to hunt up for you. Most of the delay which has occurred is caused by the failure of the person making the application to state all the essential facts.

All of this relates to *defense extensions only*. If you want to make an extension or buy new equipment and cannot support your need by reference to growth of demand caused by a defense project or industry in your territory, you must be patient with your suppliers and let time work out the situation.

A special memorandum concerning the maintenance and repair rating system will be sent by direct mail to every member of the association as soon as it is released by O.P.M. Its availability is a matter of a few days only. This arrangement will give an automatic rating to water works maintenance and repair items, *provided* that the head of the department or company has filed the proper form of

application and has received his rating number. Read the material carefully when it reaches you and act in accordance with the instructions contained therein.

❦

An exchange of correspondence between Surgeon General Parran and Priorities Director Stettinius (recorded in the July JOURNAL) has now been formalized by orders issued by Messrs. Stettinius and Henderson. O.P.M. order M-19 filed July 28, 1941, records that Producers may deliver chlorine only in accordance with directions embodied in the order. As is the custom of the O.P.M., delivery of chlorine for "Defense" purposes is given priority.

On July 30, 1941, O.P.A.C.S. Administrator Leon Henderson filed document 1335 (Federal Register Vol. 6, July 31, 1941) which is a civilian allocation program for chlorine. It reads as follows:

"The total defense and civilian demand for chlorine is in excess of the available supply. To insure the obtaining of priority for deliveries of chlorine under present and future contracts and orders and related sub-contracts and sub-orders related to military defense needs, the Priorities Division, Office of Production Management, has issued General Preference Order No. M-19 to conserve the supply and direct the distribution of chlorine. Such order will further diminish the supply of chlorine for civilian purposes. It is necessary, therefore, after military defense needs are satisfied, to provide for the equitable allocation of the residual supply of chlorine among competing civilian demands.

Accordingly, pursuant to and under the authority vested in me by Executive Order No. 8734, particularly Section 2(a) thereof, the following program is announced:

1335.1 *Allocation of Materials.* Adequate supplies of chlorine shall be allocated for the following uses:

Water purification
Sewage treatment
Sanitation
Refrigerant gases for existing equipment
Slime control in industrial plants
Preparation of products for medicinal use
Preservation and processing of food products

1335.2 *Avoidance of Excessive Inventories.* Preferences granted under this program shall not be used to accumulate excessive inventories.

1335.3 *Definitions.* The terms used in this program shall be defined as they are defined in General Preference Order No. M-19.

1335.4 *Enforcement.* The foregoing program is to be administered and enforced by the Office of Production Management

Issued this 30th day of July, 1941.

LEON HENDERSON
Administrator

Water works men should have no doubt that the importance of public water supply is recognized by every responsible official in Washington.

They should also be loyally reminded that there is now going on in the United States the most rapid and tremendous industrial expansion program that history has ever known. Things will fit together in time and every worth while project and activity will get the treatment that it merits.

This is a time for water works men to demonstrate their fine patience and co-operation in the adjustments that are being made.

HARRY E. JORDAN
Secretary

August 4, 1941

→ *(Copy of Form for Guidance Only)* ←

PD-1

OFFICE OF PRODUCTION MANAGEMENT
PRIORITIES DIVISION
WASHINGTON, D. C.

No. _____
ALLOTMENT DIVISION

ORIGINAL

APPLICATION FOR PREFERENCE RATING

Sheet One (page 1 of 4)

Instructions.—Applicant must be *the user* of the material, equipment, or service, excluding labor, hereinafter called "material." A separate application must be filed for each case presented. "Each case" means each need for specific material which can be filled by a *single* Supplier and which is for use in completing a specific contract (except as may be set forth in Par. 4.b). Thus, separate orders with a Supplier may be covered by a single application, if the material on each order is similar and for use in completing the *same* covering contract(s). If orders for identical material are placed *with several* Suppliers, a separate application must be filed for *each* Supplier. All information deemed relevant by the Applicant should be included in the application form; if space does not so permit, a supplemental typewritten statement may be attached. **APPLICANT WILL RETAIN QUINTUPLICATE, AND SUBMIT COMPLETED APPLICATION IN QUADRUPLICATE TO DIRECTOR OF PRIORITIES, OFFICE OF PRODUCTION MANAGEMENT, WASHINGTON, D. C. PLEASE USE TYPEWRITER.**

Date _____

1. _____
LEGAL NAME OF APPLICANT

_____
ADDRESS

_____
ADDRESS OF PLANT(S) IN WHICH MATERIAL IS TO BE USED

hereby requests issuance of a Preference Rating on the following material valued at $_____

Item No.	Name and Description of Material	Promised Delivery Date(s)
1		
2		
3		
4		
5		
6		

*REQUIRED DELIVERY SCHEDULE	1st Delivery *Date	2d Delivery *Date	3d Delivery *Date	4th Delivery *Date	5th Delivery *Date	6th Delivery *Date	7th Delivery *Date	8th Delivery *Date
ITEM 1								
Unit Quantities								
ITEM 2								
Unit Quantities								
ITEM 3								
Unit Quantities								
ITEM 4								
Unit Quantities								
ITEM 5								
Unit Quantities								
ITEM 6								
Unit Quantities								

order for which has been placed by Applicant with: (If order not placed, check here ☐ *and explain why under Par. 6a.)*

2. _____
NAME OF SUPPLIER OF WHOM PREFERENCE RATING IS REQUESTED

Supplier's address _____

Applicant's Order No. _____ Dated _____

**Delivery Dates are arrival dates of material at Purchaser's Plant. Installment deliveries must be scheduled when partial deliveries will meet requirements. If necessary, delivery schedules may be attached as a part hereof.*

16—29184

3. If Applicant has pending, or intends to file application for other material for the same product or use for which the material specified in Par. 1 is required, list for each such application:

Name of Supplier	Name and Description of Material	Date of Application

4. *a.* Supply the following information with respect to *the product* in which the material specified in Par. 1 will be used:

Name and Description of Product	Unit Quantities	Approx. Value	Delivery Date(s) scheduled in Contract(s) or Order(s)	% of Completion of Contract(s) or Order(s) specified in 4 b

If Preference Rating has been assigned to the product specified in 4 *a*, state Preference Rating _____ Certificate No.(s) _____ Unit quantities _____

*b.** Identify contract(s) or order(s) for the product specified in 4 *a*;

(1) If Applicant's customer is a governmental agency, state:

Supply Arm or Bureau _____ Contract No. _____
COMPLETE NUMBER

(2) If Applicant's customer is not a government agency, state:

Name _____

Address _____

Customer's Order No. _____ Date of order _____

*If numerous contracts or orders are involved, a Summary, making distinction between government and civilian orders, will suffice in lieu of answers to 4 *b* (1) and 4 *b* (2).

*SUMMARY:

c. Explain how the material specified in Par. 1 (or its ultimate use) is deemed essential to the National Defense Program. If not essential to the National Defense Program, state why application is being made:

Paragraph 5 is not to be answered if material specified in Par. 1 is a machine tool (or other capital equipment)

5. *a.* State unit quantities of material specified in Par. 1 which are
   (1) In stock: Quantity _____ Estimated percent of annual consumption _____
   (2) In transit _____
   (3) Promised for delivery *excluding quantities specified in Par. 1* _____
   b. Will *all* the material specified in 5 *a* be used in completing the contract(s) or order(s) specified in 4 *b*? Yes ☐ No ☐ (Check one.)

   c. If answer to 5 *b* is "No," state:
   (1) Unit quantities of material specified in 5 *a* which will not be so used:
   (2) The use which will be made of material specified in (1):

   (3) Relationship of such use to National Defense Program:

Applicant should detail fully in paragraphs 6, 7, and 8 what efforts preceding the filing of this application, he has made to satisfy his requirements without a Preference Rating.

6. *a.* State sources of supply contacted:

Name and Address	Results or Replies and Other Details

   b. State efforts to "farm out" parts of contract(s) or order(s) specified in 4 *b*:

Name and Address of Companies Contacted	Results or Replies and Other Details

7. What alternatives or substitutes could be used in lieu of material specified in Par. 1:
   a. Identify alternatives or substitutes _____
   b. State extent of possible use _____
   c. State unit quantities: In stock _____ Available _____
   d. State effect in terms of price, quality, etc.

→ *(Copy of Form for Guidance Only)* ←

Paragraph 8 to be answered only if material specified in Par. 1 is a machine tool (or other capital equipment).

8. State basis of operations in plant(s) or department(s) of plant where material in Par. 1 is to be used:

Name and Address of Plant(s)	Hours of Operation per Week	No. of Men on Each 8-hour Shift		
		First	Second	Third

9. Are there any conditions or circumstances, other than delivery of the material on the *Delivery Date(s)* specified in Par. 1, which would interfere with completion on schedule of the contract(s) or order(s) specified in 4 *b*? Yes ☐ No ☐ (Check one.) If "Yes," explain:

10. Additional relevant information which applicant may wish to present:

---

11. Read carefully and strike out each subdivision of the following to which you are unable to certify and attach a statement of the reason or reasons why such certification is impossible in each instance.

We hereby certify that, to the best of our knowledge and belief, (1) the material specified in Par. 1 is to be used in connection with the production of the contract(s) or order(s) specified in Par. 4 *b*; (2) the inventory of and orders for such material referred to in Par. 5 are and will be used exclusively in connection with the production of the contract(s) or order(s) specified in Par. 4 *b* except as may be set forth in Par. 5 *c*; (3) the material in Par. 1 is essential to the completion of the contract(s) or order(s) specified in Par. 4 *b*; (4) the quantities specified are not greater than needed for the contract(s) or order(s) specified in 4 *b*; (5) the indicated *Required Delivery Date(s)* is not earlier than the actual need for the material specified in Par. 1; and (6) delivery of the material specified in Par. 1 on the specified *Required Delivery Date(s)* will permit completion according to schedule of the contract(s) or order(s) specified in Par. 4 *b*, except as may be set forth in Par. 9.

Subscribed and sworn to before me this ..... *day of* ....., *1941.*

.....
LEGAL NAME OF APPLICANT

By .....
SIGNATURE OF OFFICIAL AND TITLE

.....
Notary Public.

U. S. GOVERNMENT PRINTING OFFICE 16—80164

The Maintenance Order

The official O.P.M. order putting into effect the June 26th statement of Civilian Supplies Administrator Henderson concerning special civilian services has as yet (Sept. 4, 1941) not been formally issued. Great confusion was caused by the publicity release on August 7 referring to the order, which was withdrawn after it had been announced, but before the procedure could be put into effect.

It is now momentarily expected in the form of a Maintenance and Repair Order to cover water, electric, gas and heat utility services. It is understood that the order will cover the necessary materials for maintenance and repair of water supply works as well as the operating supplies required to furnish their service.

It is also understood that the terms of the order may be applied to the extension of service to consumers along streets where mains are already laid. These extension items will include the service line material, meters and all accessories. There is a possibility that it may be interpreted to include minor extensions to distribution mains where necessary, in order to give full service in areas already included within the general distribution system. An agreement upon the part of a water works superintendent or manager to comply with the terms of the order is to be executed on form P-23 (not yet available). Immediately upon receipt of official information concerning this order and its content a special bulletin will be sent to every member of the American Water Works Association.

While the above information is at the moment unofficial, it has been received from reliable sources and is transmitted through the medium of this JOURNAL for the information of all members of the Association.

HARRY E. JORDAN
Secretary

September 4, 1941

(*over*)

Notice to Water Works Superintendents

Information has been received in this office which indicates that executives of some water works properties have been requested by individuals (not clearly identified to the superintendent) to furnish information concerning the system or services. As a part of the National Defense effort, there are a number of official agencies which have an interest in water supply services. This office is reliably informed that representatives of all such governmental agencies, who may be assigned to the collection of data concerning water works plants, are provided with adequate identification papers and have been instructed to introduce themselves by means of this identification material whenever they call upon water works executives. The order underlying this procedure is so formal that water works superintendents may consider themselves definitely obligated to require adequate identification before they give information concerning their property to any individual who may call upon them for such purposes.

HARRY E. JORDAN
Secretary

September 4, 1941

APPLICATION FOR MEMBERSHIP
IN THE
AMERICAN WATER WORKS ASSOCIATION
22 EAST 40th ST., NEW YORK

Date:.....

..... hereby make application for
(I or We)

.....
(Active, Junior, Corporate or Associate Membership, or Affiliate)

in the American Water Works Association, and enclose herewith the sum of $....., one year's dues in advance.

Name.....

Company or Department.....

Title or Position.....

Address.....

.....

If application is for Junior Membership, give date of birth.....

If application is for Affiliate, state number of active services in property where employed.....

Nature of business or character of work (for office records).....

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If application is for Corporate or Associate Membership, it must be signed by the person designated to represent the firm or corporation in A.W.W.A. activities.

.....
Signature of Applicant.

Application obtained by:

.....

(over)

ARTICLE I OF BY-LAWS

Section 3. An Active Member shall be a superintendent, a manager, an official or employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, or any qualified person engaged or interested in the advancement of knowledge relating to water supplies. (Annual Dues, $10.00.)

Section 4. A Corporate Member shall be a Water Board, Water Commission, Water Department, Water Company or Corporation, National, State or District Board of Health, or other body, corporation or organization engaged or interested in water supply work, and shall be entitled to one representative whose name shall appear on the roll of members, and who shall have all the rights and privileges of an Active Member. This representative may be changed at the convenience and pleasure of the Corporate Member on written notice to the Secretary. (Annual Dues, $15.00.)

Section 5. An Associate Member shall be either a person, firm or corporation engaged in manufacturing or furnishing supplies for the operation, construction, or maintenance of water works. (Annual Dues, $25.00.)

Section 6. A Junior Member shall be an employee of a municipal or private water works; a civil, mechanical, hydraulic, or sanitary engineer, a chemist, a bacteriologist, a student or any otherwise qualified person engaged or interested in the advancement of knowledge relating to water supplies. At the time of his admission he shall be not less than eighteen years of age. His connection with the Association shall cease when he becomes twenty-five years of age, unless he is regularly enrolled as a student in a university or has previously transferred to the grade of Active Member. Junior Members shall receive the Journal and all privileges of Active membership except holding office and voting. (Annual Dues, $5.00.)

Section 7. An Affiliate shall be any person otherwise qualified for Active membership who, at the time of application, is not nor previously has been a member of the Association and who, for acceptable reasons, does not wish to become an Active Member.

No corporation, firm or partnership which otherwise would be entitled to the grades of Associate or Corporate member may hold the grade of Affiliate. No employee of an Associate member may become an Affiliate. No person who is the superintendent, the manager, the chief engineer, the superintendent of filtration, the chief chemist, or the superintendent of distribution in a plant having more than 3,000 active services, is eligible for the grade of Affiliate. Under unusual conditions, exception to the above may be made by action of the Executive Committee if the applicant sets forth fully the reasons for the exception when applying for the Affiliate grade.

Affiliates shall not be entitled to vote upon general Association questions, and not eligible to hold office in the Association, nor in any of its Divisions. They shall be eligible to vote upon Section questions and to hold Section offices except those of Chairman, Vice-Chairman, Secretary (and/or Treasurer). They shall be entitled to all other rights and privileges of Active Members. Affiliates receive the March, June, September and December issues of the Journal each year. (Annual Dues, $4.00.)

Memberships will be dated as of the beginning of the quarter in which the application is received.

Membership in the Association carries, also with no additional dues, membership in its Local Sections and National Divisions, and includes the Journal, a monthly publication devoted to water works interest. The proceedings of the annual conventions and of the meetings of the Local Sections are published in the Journal, which also contains contributed articles on subjects pertaining to public water supplies.

Latest News From the O. P. M.

❦❦❦ The A.W.W.A. is *reliably* but not *officially* advised that, under the the terms of Preference Rating Order P-46, a "minor capital addition"—section (a) (6) (ii)—may be considered to be any unit installation of materials having a dollar value *not in excess of $1,500.00*, provided that such installation is within the logical limits of the existing service area of the water utility.

❦❦❦ Department heads are cautioned not to proceed, under this interpretation, with the installation of a series of separate jobs, which have in fact a connected relationship and are a project designed to afford a major increase of production facilities or a substantial extension of a service area.

❦❦❦ The use of the *Project Application* is necessary if a major extension of production or distribution facilities is contemplated. The A.W.W.A. staff continues its policy of taking such applications to Washington and placing them in the hands of the responsible person in the O.P.M. It is not, however, possible to follow up such applications until they are approved. If water departments desire extended service of that character, arrangements can be made for water works engineers to render such service upon a per diem basis.

❦❦❦ There follows an *unofficial* but *reliable* outline of the information which must be included in a project application.

If a water works executive needs to make an extension of works facilities in order to meet demands created by:

(a) a defense industry
(b) an Army, Navy, or other military training center
(c) a defense housing project
(d) large increase in population due to defense activities
(e) growth of population/deficiency of capacity

an application for a project preference rating should be made.

The following information must be included in all applications for a preference rating order covering a water works project:

1. Name of operating company or agent

2. Location of project

3. A clear, short statement of the scope of the project (whether a well or group of wells, a unit in a station, an entire pumping station, a filtration plant, a transmission or distribution line, etc.), and relation of any existing or proposed construction. A map showing relation of project to existing facilities is essential.

4. Comprehensive statement of function of proposed project (whether to create added production facilities, to deliver water from existing facilities, to insure continuity of delivery, etc.).

5. Statement with supporting data on relation of project to national defense. Tabulation should be submitted showing volume of load created by defense activity. This amounts to an engineering report or brief in support of the need. It should tell everything related to the situation. If the project is designed to serve a defense industry, training center, etc. which has a priority rating for its direct use, reference should be made to the defense project and to the rating assigned to it in the application for the water department.

6. A statement of the urgency of the need for the proposed construction including estimate of existing and scheduled dependable capacity. Net requirements for next three years (in case of water and sewage treatment plants). Claim for immediate need should be fully supported, preferably by a summary of analyzed results and by a statement from the State Dept. of Health.

7. A statement concerning interconnections with neighboring utilities. If services exist or are possible, state extent and capacity to which they are, or could be utilized and the extent to which they could make available to others any capacity of your system.

8. Latest practicable date of introduction of project into operation.

9. A statement of the aggregate dollar cost of the project and, where applicable, remaining cost where the project is under construction, exclusive of labor.

10. Schedule of the various larger elements entering into the project. For each element list the expected source of your procurement, the latest practicable delivery dates, estimated costs, exclusive of installation labor. The aggregate dollars involved in these items should approximate 80 per cent of the total dollars involved in the project.

11. A careful estimate of the total quantity and where possible, the weight of the critical materials involved in the entire project such as copper, steel, cast iron and aluminum.

12. The application should be a sworn statement by an executive officer of the applicant.

HARRY E. JORDAN
Secretary

November 1, 1941

All over America

WATER LINES GO DRESSER

Using no tool but a wrench, relief laborers installed this 36" equalizing-pressure main at Buffalo, N. Y., in record time. During the first 8-hour day, a green crew, totally unfamiliar with pipe-line work, laid seventeen 40-ft. pipe sections.

NEW YORK

Count New York State in the roster of states that have found Dresser Couplings are the key to important pipe-line savings. A high percentage of the tremendous mileage of lines required to serve its populous towns and cities are Dresser-coupled. For Dressers make water lines permanently tight and leak-proof—protect them against expansion, contraction, vibration, and frost action—are quickly and easily installed by unskilled workmen.

Observe the swing to Dressers throughout the country! State after state answers to the roll call of enthusiastic users. Here, indeed, is a solid basis for your confidence! Plan now to use Dressers on your next line. Write for Dresser Catalog 402B entitled "How to Join and Repair Pipe."

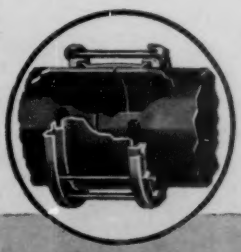
DRESSER MANUFACTURING COMPANY

PIPE COUPLINGS AND REPAIR DEVICES SINCE 1880

Bradford, Pa.

District Sales Offices: New York, Chicago, Houston, and San Francisco. *In Canada:* Dresser Manufacturing Company, Ltd., 60 Front St., W., Toronto, Ont.

Cutaway view (right) of Dresser Steel Coupling, Style 38, shows working principle. Plain-end pipe is used. The *resilient* rubber-compound gaskets, flexing with the pipe, safely absorb pipe movements, thus preventing failures that often occur with rigid joints. A real advantage!



SIX REASONS WHY MODERN WATER LINES ARE DRESSER-COUPLED:

1. **PERMANENT TIGHTNESS**—*proved* for 50 years, on 150,000 miles of pipe.
2. **FLEXIBILITY**—allows for expansion and contraction, trench irregularities, curves, grades, etc.
3. **SIMPLICITY**—joints are "factory-made"; ordinary labor installs.
4. **SPEED**—typical examples: 8 min. for 14"; 12 min. for 20"; etc. (2 workmen).
5. **STRENGTH**—predetermined; joints safely withstand any specified pressure.
6. **TRUE ECONOMY**—a *truly* lower joint cost throughout the life of the line.

Approved by Underwriters Laboratories, Inc.

DRESSER COUPLINGS FOR EVERY LINE EVERY TIME

LEADITE

Trade Mark Registered U.S. Pat. Office

Jointed for . . . Permanence with LEADITE

Generally speaking, most Water Mains are buried beneath the Earth's surface, to be forgotten,—they are to a large extent, laid for permanency. Not only must the pipe itself be dependable and long lived,—but the joints also must be tight, flexible, and long lived,—else leaky joints are apt to cause the great expense of digging up well-paved streets, beautiful parks and estates, etc.

Thus the "jointing material" used for bell and spigot Water Mains MUST BE GOOD,—MUST BE DEPENDABLE,—and that is just why so many Engineers, Water Works Men and Contractors aim to PLAY ABSOLUTELY SAFE, by specifying and using LEADITE.

Time has proven that LEADITE not only makes a tight durable joint,—but that it improves with age.

The pioneer self-caulking material for c. i. pipe.
Tested and used for over 40 years.
Saves at least 75%

THE LEADITE COMPANY

Girard Trust Co. Bldg. Philadelphia, Pa.

No Caulking